Railway Mechanical Engineer

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Recent years in railroad activities, as well as in the industrial field, have been characterized by a rapidly growing recognition of the importance of the human factor as compared to that of material resources and facilities. Many practical railroad men have been inclined to smile at the mere mention of the use of mental and psychological tests as applied either to the selection of new employees or in studying the problem of improving the standards of the present organization. One of the most important contributions which have been made to the consideration of the question of determining the fitness of employees in the mechanical department, was a report presented at the recent meeting of the International Railway Foremen's Association, which is reproduced alsewhere in this issue. It is important to recognize in studying this report, that it applies not alone to the shop crafts apprentices, but to every employee in the mechanical department, whether he works in the shop or the office, or regardless of whether he is just starting in, is an old employee, or has already been promoted to a supervisory or official position. The International Railway General Foremen's Association is to be congratulated upon having had presented such an able and comprehensive report on so vital and far-reaching a problem.

The human factor

During a recent trip through a railroad general repair shop, one of the points of interest visited was the wood mill. Every possible square foot of the 125-ft. by 325-ft. floor area was covered with wood working machinery being pushed to turn out finished lumber for use over the entire system, and yet the shop had great difficulty in meeting the production demands. Many of the machines were old, and obsolete when compared with modern wood mill equipment. It was the opinion of the foreman in charge that the production demands of the system could readily be met with less men at reduced cost if the obsolete machines were replaced with modern machinery. The use of steel in bridge, car and building construction has greatly increased during the past 25 years, and this has affected the relative proportion of steel and wood used in repairs by the railroads. This has, no doubt, detracted from the interest with which the operation of the wood mill is regarded; it is considered as a facility of constantly decreasing importance. Irrespective of the relative importance of wood and steel, however, the actual amount of lumber to be dressed and shaped has in many cases not decreased and, in some cases, it has actually increased till the neglected mill facilities are overloaded and have to resort to many uneconomical expedients to keep up with the demand. One eastern railroad, for example, uses approximately 100,000,000 board feet of lumber annually for bridge timbers, car material, etc., exclusive of ties. Do not quantities such as these suggest that to neglect the needs of the wood mill for efficient machinery is likely to prove an expensive oversight?

Don't neglect wood mill equipment

The following editorial is quoted in full from the June, 1914, issue of the Railway Age Gazette, Mechanical Edition, now the *Railway Mechanical Engineer*: "A master car builder, who has given much time and observation to the study of the draft gear problem, in commenting on our competition which closed on May 15, suggested that far too little attention is given to the proper upkeep and maintenance of that part of the equipment. One of the most important functions of the draft gear is to protect the car from damage in transmitting and absorbing the pulling and buffing stresses. It is therefore of prime importance that it be kept in good condition and that such repairs or replacements as are necessary from time to time be made promptly. The draft gear, unlike most of the other important parts of the equipment, is located where it is difficult to inspect it, and especially to observe its action under working conditions. Because it is out of sight, little thought is given to it unless its condition becames so bad that serious damage is done to other parts of the car. Then it is immediately condemned because of its failure, although such failure might easily have been prevented if the gear had been inspected more regularly and more carefully, and a few slight adjustments had been made to compensate for the wear and deterioration.

Maintenance of draft gear

"When wheels are applied to a freight car, it is with the expectation that they will have to be renewed in a period of five years or less. Different parts of the air brake are periodically inspected, and cleaned and repaired at a heavy expense. And yet in spite of the severe demands made upon it, the draft gear is expected to do duty indefinitely without wear or breakage, and if it fails it is severely condemned. The master car builder, referred to above, after making a careful check, has come to the conclusion that the draft gear should be overhauled after it has been in service about five years. If done at this time the conditions are such that the expense will be less than if a longer period is allowed to intervene and greater insurance will be afforded the car and its lading. If thoroughly overhauled and readjusted it is expected that the gear will continue in service for another four or five years without any very great amount of attention."

Have the 13 years which have intervened since this editorial was written produced a draft gear which will not

wear out? Need we expect the next 13 years to produce one? Might we not as well face the facts now and prepare to prolong the life of cars and reduce the destruction of lading by spending a reasonable amount in systematic draft gear maintenance to give the draft gear a chance to perform its function of protection consistently and continuously?

What is a hot box?

During the past year, a questionnaire consisting of twenty-nine questions bearing on the hot box problem was submitted to a number of southwestern railroads. One of the questions requested the basis on which miles per hot box failure was calculated. Some roads in compiling their records of car-miles per hot box, used as a basis only those cars that were set out on the line, others counted all of the cars that caused a delay, while still others counted all journal bearings that required attention from the train crews, regardless of whether or not there was a delay incidental to this work. This wide divergence in the definition of what constitutes a hot box makes it most difficult to formulate a true basis of comparison of the results that the different railroads are obtaining in combating this problem. Furthermore hot box data compiled under such different conceptions as to what constitutes a hot box, do not always represent the true facts, but do in many cases, reflect to the disadvantage of some roads that are really making a creditable showing. It would be to the mutual advantage of the railroads to adopt a standard definition as to what constitutes a hot box and also a basis on which car-miles per hot box should be figured. The compilation of this data could be further simplified and made more uniform by adopting a standard report form on which to report all hot box failures. By doing this the railroads would be in a position to compile uniform statements showing car-miles per hot box for the system, for the division or district and for the individual car. By adopting such standards, the railroads would in time be able to set up accurate records in terms that would be clearly defined and generally understood. Without such records, supervisory officers are unable to examine past performances intelligently and to use them as a guide for present and future practices.

How much do economy appliances save?

Not everyone realizes the debt the railroads and the country at large owe to manufacturers of equipment specialties and appliances, who in many instances, after bearing all the expense of engineering development work and establishing the merit of their devices by extensive service tests, sell these devices to the railroads in spite of seeming indifference and, in some cases, actual opposition. An interesting comment on this situation was made at the last convention of the International Railway Fuel Association by N. D. Ballantine, formerly assistant to the president of the Seaboard Air Line. He said:

"I take off my hat to the manufacturers and supply men who, through their pioneering and persistence and patience, are virtually forcing the railroads into greater economies. With the rapid strides made during the past few years in fuel saving devices, it is fair to assume that all new locomotives and a goodly portion of those owned in 1920 which are still being used, have been equipped with one or more of such devices. A conservative estimate of the possible savings of fuel through several of the more prominent devices, such as the superheater, thermic syphon, booster, feedwater heater, brick arches and back pressure gages, aggregate 50 per cent to 75 per cent." Mr. Ballantine said that some method of equating the economies obtainable from various fuel saving devices is absolutely essential in order that the maximum amount of obsolete equipment may be retired and a direct return shown upon investments in modern fuel saving devices.

In line with the thought expressed, one thing needed above almost everything else in modern railroading is an accurate knowledge of operating effects and a fixed determination, in comparing operating performance data, not to overlook any of the seemingly unrelated factors which may have an important bearing on the final result. For example, the quality of fuel must be given due attention in checking fuel consumption figures on a thousand gross ton-mile basis since the burning of an appreciably higher grade of fuel during one period under consideration may indicate an improvement in locomotive conditions and operations entirely unwarranted by the facts.

Problems of the younger men

The Fifth annual Younger Railroad Men's Conference, recently held at Jacksonville, Fla., under the general supervision of the Transportation Department of the Y. M. C. A., is of particular interest to the mechanical department and its officers. While the 292 young men who attended this meeting were selected from all departments of the railroads and came from all over the country, a very large percentage were from the mechanical department, many of them being shop crafts apprentices. The young men spent three days in discussing some of the more important problems confronting them, but special attention was given to helping them to gain a correct impression of the importance of the railroads in our economic structure and the great variety of opportunities which are open to young men who select the transportation field for their life work.

A large number of railroad officers gave generously of their time to discuss vocational problems with the young men in small groups and individually. It was clearly evident that most of these young men are anxious to find their proper place in the railroad organization and are willing to work and study hard to prepare themselves. They were greatly helped by coming in contact with railroad officers, and undoubtedly the officers who participated in the vocational counseling will be inspired to take a greater interest in all of the young men working under them.

The full value of an international conference of this sort—young men from Canada and Mexico were also represented—will not be achieved unless those who attend the conference carry its spirit back to the offices or shops in which they are working. The number of young men who can be accommodated at a conference of this sort represents only an insignificant proportion of all of the younger men engaged in railroad work. It is feasible, however, through the formation of American Railway Employed Boys' Clubs and similar organizations, to reach most of the young men who are ambitious to improve themselves and make the most of their lives.

It is significant that there were several observers at the Jacksonville conference who were studying it with a view to recommending system or regional conferences of a similar nature. The Chesapeake & Ohio has held several younger railroad men's conferences and undoubtedly the railroads on the Pacific coast will continue regularly to follow up their first conference last year.

The indications are that the number of regional and system conferences which will be held during the coming twelve months will be greatly increased. It is to be hoped that mechanical department officers generally will recognize the value of such conferences and assist not only in the programs, wherever they are called upon so to do, but in the follow-up work on their own roads and in their own localities.

Do you know the answer?

Asking questions, it is agreed, is one of the best ways to obtain information, not only by the man who does the asking, but also by the man who has to dig up the answer. It is a good thing for all of us to have to admit once in a while that we don't know.

There are quite a number of questions in connection with the development of steam locomotives to which many mechanical department officers should know the answers. Ask yourself this question, "What do you know about the modern steam locomotive?" and then try to answer it by considering the answers to the questions in the following list:

What is the status of the compound locomotive today in view of rising steam pressures and fuel costs?

What is the maximum boiler pressure that can be economically used in simple locomotive cylinder?

What is the maximum axle load permissible on the usual open-hearth steel rails which will not inflict injury to the metal?

Should combustion chambers be used in locomotive boilers when they can be avoided?

What do you consider to be a satisfactory locomotive boiler?

What trouble has so far been experienced with high boiler pressures on locomotives?

What advantages are claimed for poppet valves when used with locomotive cylinders?

How can you justify four-wheel engine and trailer trucks when used on the same locomotive having three driving axles?

Why are not test results indicative of locomotive fuel rates over long periods?

Some of these questions are answered in an article published elsewhere in this issue, or have been answered in articles that have appeared in previous issues of the *Railway Mechanical Engineer*. See if you can find the answers and whether or not you agree. Regardless of whether you do or do not, write and tell us your opinion. Our columns are open for just such discussions.

Improving the service of materials

In his address at the 1927 annual meeting of the American Society for Testing Materials, the president of the society, J. H. Gibboney, chemist of the Norfolk & Western, made the following statement: "The importance of the study of materials under conditions of use has long been recognized as one of the strongest means of assurance in determining the suitability of a material for a given service. This method of testing has been a safeguard of the greatest importance. It has been our observation, however, that both the producer and the users of materials have in many instances failed to profit by this source of information for lack of proper contacts that would develop increasing interest and confidence between the engineers of the two parties concerned."

To illustrate the kind of results that can be accomplished by this sort of research, Mr. Gibboney told of what had been done by his road in a study of locomotive side rod consumption. It was found during 1925 that the consumption of rod forgings was running very high. Among other things which were done as the result of an analysis of the situation, the design was strengthened. Research suggested the use of a simple alloy steel as a more satisfactory material for the stress conditions, and technically trained apprentices were placed in the shops with the duty of seeing that strictly approved methods were adhered to both in the forging, heat treating and machining. The results of bad practices, such as the rupture of surface metal by heavy sledging which starts progressive fractures, and finishing with sharp shoulders and improper fits, were brought forcefully to the attention of the shop and enginehouse forces. No identification marks were permitted to be cut into the material, except on grease cup projections. This program started in the middle of 1925 and resulted in a reduction from an average of 14.8 lb. of side rod forgings consumed per 1,000 locomotive-miles in 1925, to 7.4 lb. per 1,000 locomotive miles in 1926, and a still further decrease during the first third of the present year to 4.5 lb. per 1,000 locomotive-miles.

Here is a splendid illustration of the value of scientific thoroughness in undertaking the improvement of an unsatisfactory condition of equipment operation and maintenance. Not one, but every phase of the problem was investigated, including design, the suitability of material and the correct handling of the material.

In undertaking the use of improved materials, particularly steels which depend upon some form of accurately conducted heat treating process for the full development of their improved physical properties, unsatisfactory results have often followed the failure to consider the bearing which correct detail design and proper handling in the shop and on the road has on the ultimate performance of the material. The advantages which such materials offer in weight and strength have long been recognized, but too little attention has been given to determing the real causes of failures and the materials in some cases have unjustly borne the entire blame for whatever disappointment has followed their use. Scientific thoroughness in investigating and analyzing such situations is very much needed.

Mr. Gibboney's statement, however, implies that there is a dual obligation in this matter, the discharge of which depends upon closer contact between the engineers of the two parties concerned. The railroads can do much in modifying their own practices to suit the requirements of special materials with desirable physical properties. Is it too much to suggest that the producers of special steels may also do much to improve their service to the railroads, and to improve their own market, if in their own research work they will give equally close attention to the peculiar conditions under which their materials must operate and be maintained in railway service?

New Books

FIVE THOUSAND SHEET STEEL PRODUCTS. *Compiled by the Sheet Steel Trade Extension Committee.* 445 *pages, illustrated.* 8 *in. by* 11 *in. Bound in boards. Price* $3.00. *Published by the Committee, Oliver Building, Pittsburgh, Pa.*

This book is primarily a directory of the manufacturers of sheet steel products and marks the beginning of a new service on the part of the Sheet Steel Trade Extension Committee to buyers, sellers and fabricators of sheet steel products. It contains data on the United States weights and gages for iron and steel sheets, and a list of simplified types, gages and sizes of sheets. The larger portion of the book is taken up by a list of over 5,000 sheet steel products and the names of the manufacturers who make them.

Rail car equipped with International Harvester high pressure steam power plant

Rail car driven by steam

International Harvester high pressure power plant also adaptable to switch engine drive

A HIGH pressure steam power plant for transportation purposes, including rail car and switch engine drive, has been in the process of development in the laboratories of the International Harvester Company, Chicago, for several years. The first application of this power plant has been in the 73-ft. passenger-baggage car illustrated. The power plant is a distillate burning, direct mechanical drive unit designed to be noiseless, smokeless and easy riding, with ample power for hauling additional trailer tonnage. This unit, which is known as the "Locomotor," has been thoroughly tested in recent months and plans are under way to place it in regular service in the Chicago territory in the near future.

The car has a 17-ft. baggage compartment in one end which also contains the steam generator and auxiliary power equipment. The present seating arrangement provides for 63 passengers. But one operator is required as far as running the car and the power plant is concerned; duplicate controls, provided on the platforms for operation in either direction, consist merely of the familiar throttle, reverse lever and air brake valve handle.

The self-regulating power plant is designed to develop 300 hp. at the wheels and requires no attention after the working steam pressure is once attained, which takes 15 to 18 minutes from a cold system, or three minutes after the main burner has been lighted. Steam is developed at 600 lb. pressure and 200 deg. of superheat in a steam generator 4 ft. in diameter, located in one corner of the baggage compartment. This steam is used to operate one auxiliary engine generator set inside the car and two eight-cylinder uniflow engines, supported under the body of the car and arranged to drive through suitable propeller shafts and gears to the inside axle of each truck.

The steam exhausts into condensers

The exhaust steam from these engines is conveyed to condensers on the roof at each end of the car where the steam is condensed, the condensate then being passed through an oil separator and returned to what is known as the hot well. A feed-water pump takes water from the hot well at a temperature of about 130 deg. F. and injects it into the steam generator from which it again passes out as superheated steam to the engine. The system is thus closed, the only water required being about 4 gal. of make-up water a day. This re-use of the condensate, together with extremely rapid forced circulation, it is stated, prevents the deposit of scale in any part of the circulating system. Condensation of the exhaust steam eliminates this common source of noise and the provision of preheated air and a carefully regulated blower assure practically complete combustion and the absence of smoke. Adequate provision for heating, when necessary, is made by diverting part of the exhaust from the auxiliary engine through suitable heater pipes.

The fuel used may be any ordinary grade of distillate readily procurable in the open market. Tests of the car illustrated are said to show a fuel consumption of one gallon of distillate, at a cost of about 5½ cents, for 1½ miles, or over 100 ton-miles of operation. The completeness of the combustion secured is indicated by the absence of accumulated carbon deposit in the generator after two years' service. Analysis of the flue gases is said to show carbon dioxide with a slight excess of oxygen and complete absence of carbon monoxide.

The flame of the burner is controlled by the steam pressure in the generator within narrow limits. When the pressure reaches 600 lb. the flame is extinguished, being re-ignited when the pressure reduces to 550 lb. Steam pressure gages are located in the baggage room

and on each platform. The water level is shown by a special indicator in the baggage room and two lights on each platform. The system is designed to operate between ordinary terminals without requiring additional water, but should water depletion be indicated by the lights, the operator may turn a small water control valve and add sufficient water to the system to restore the level.

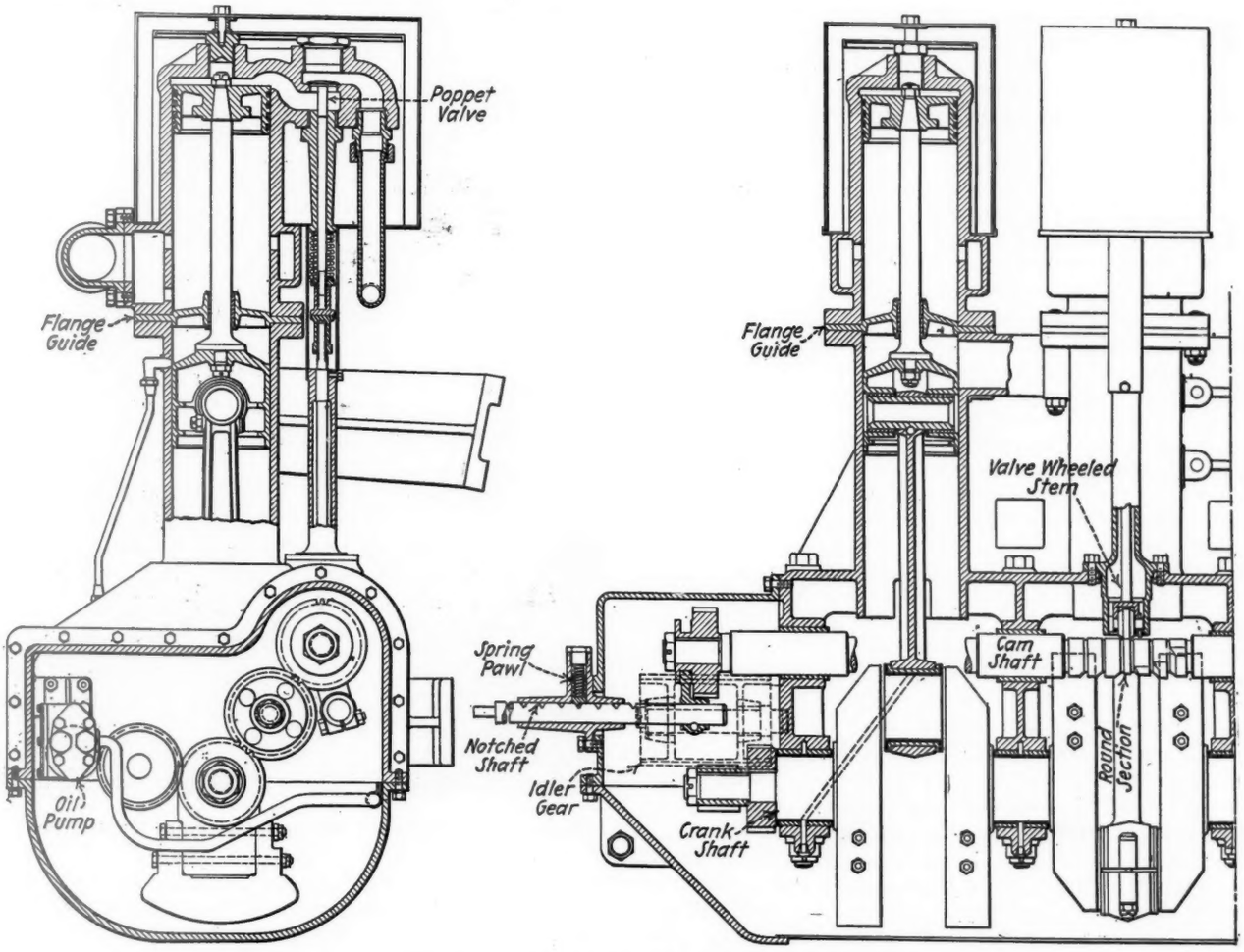
The automatic pressure regulation, and a balanced steam storage provided in the system, are designed to assure a constant supply of steam at operating pressure. The water carried in the power plant for steam generating purposes is only the approximate quantity which would be required for cooling an internal combustion engine of equivalent power. As only three of four gallons of new water are used per day in ordinary operation, the auxiliary supply may be fixed to suit any condition. The small water consumption and the distilling action of the generator are said to render unnecessary the provision of distilled, treated or carefully selected water.

The fuel tanks carry sufficient distillate for 350 to 400 miles of operation and this capacity may be increased, as there is no explosion risk involved in carrying quantities of this kind of fuel.

Steam generator

The steam generator and burner are shown in one of the illustrations. The course of the combustion element from distillate in the tank to spent gases at the stack, and the course of the power medium from water to steam and back to water again, may be followed by reference to the designating figures and letters.

At the base of the gasifier and burner is a bowl-shaped casting about two feet in diameter with a large venturi entering it at the right side. This is the vaporizing chamber. It is kept hot at all times, when the locomotive is operating, by means of a small service light *L* located directly beneath it. This service light is started initially by an electric coil which heats it, and a spark plug which ignites it. The service light and the vaporizing casting constitute the vaporizer. All fuel enters the vaporizer in atomized form, and is thoroughly vaporized by the heat of the casting before entering the main burner.



Partial cross section of the eight-cylinder, single-acting, uniflow steam engine

The service light will heat the vaporizing chamber to proper temperature in from 9 to 12 min., depending upon the outside temperature. Thereafter, the service light is kept burning; its function being not only to maintain proper temperature in the vaporizing chamber, but also to ignite the main burner as the latter is automatically turned on during operation. For this pilot light duty, its flame is directed upward through a slot formed by the outside wall of the vaporizing casting.

A motor-driven blower draws hot air from the surrounding space in the closet where the generator is located, and forces it through the venturi into the vaporizing chamber. The pipe from the blower is equipped

with a butterfly damper, actuated by a solenoid *R* which in turn is controlled by the steam pressure in the generator. When the steam pressure is down to 550 lb. per sq. in., the damper opens and allows forced hot draft to pass through the venturi, carrying distillate from the two fuel nozzles with it, and thoroughly atomizing it. This mixture of hot air and distillate entering the vaporizing chamber is prevented from going directly to the burner by a baffle plate *T*, thus keeping it in the chamber sufficiently long for vaporization, after which it passes around the baffle plate to the opening of the burner. All fuel is both atomized and vaporized thoroughly.

The main burner consists of a stack of metal rings, each ring separated from the one immediately above it and below it by washers. The gas generated by the atomizing and vaporizing process is forced out through these narrow openings where it is ignited by the service light and burns continuously until the automatic damper cuts off the blast and the fuel supply. The use of this gas and burner results in a transparent blue flame extending outward radially from the burner for about three inches. In appearance and other characteristics it is almost exactly like the flame from a Bunsen burner multiplied many thousands of times. The gas contains no globules of unvaporized fuel, and the burner operation leaves no unconsumed carbon.

The hot gases from the centrally located burner are forced outward and, seeking an outlet, pass between the closely arranged systems of spiral tubes illustrated, transmitting their heat to these tubes as they pass. Eventually they find their outlet through the gas uptake *B* which surrounds the generator and leads these gases past the upper drum chamber and to the stack. Hot gases crowding to the top of the coil chamber are slightly deflected downward by a baffle *O* to direct them into contact with the tubes before permitting them to go to the stack.

Analysis of these stack gases shows carbon-dioxide with a very slight excess of free oxygen and a temperature of 400 deg. F. In other words, the burner accomplishes practically complete combustion, and the heat left in the gases when they pass around the drum chamber is just sufficient to insulate properly the storage and separator drum *A* later described.

Hot water from a condensate well is delivered through pipe *l* to the circulating system by the feed-water pump. While the water is still at a comparatively low temperature, it is led through the water level indicator *D*.

Steam and water from the evaporator coils are carried up through a pipe to the storage and separating drum *A* where they enter tangentially near the top of the drum, and whirl around against the cylindrical sides. The upper half of the drum provides a steam storage which is out of the fire zone, and co-operates with the auxiliary moisture circulation in maintaining a constant supply of steam at all times, a characteristic not to be found in a so-called flash boiler.

From the upper center of the drum a pipe *12* leads the steam to the superheater coils *I* through which it spirals downward. The placing of the evaporator coils between the burner and the superheater tubes, provides just the proper interference to preserve the latter and still permit raising the temperature of the steam to 690 deg. F.

From the superheater coils the steam is delivered through a pipe *13* to the two uniflow engines. These engines exhaust into self-draining condensers and the condensate runs back, through an oil separator, to a hot well inside the car, whence it is promptly pumped into the generating system again.

Water level indicator

In addition to the functions enumerated, the storage and separating drum performs one of its most important services in registering depletions of water from the system.

Attached to the drum is a jacket *D* which contains the mercury terminal of a distance thermometer, and has an upper and lower fluid connection to the drum. The jacket is so positioned that, so long as a relatively full supply of water is maintained, the mercury terminal will be in contact with water from the drum. In the drum the water is of approximately the same temperature as the steam, but the water in the jacket is cooler, and is kept markedly cooler than the steam by directing the feed-water through a separate channel in the casing of the jacket before putting it into the preheater tubes.

View showing front end details including condenser fans

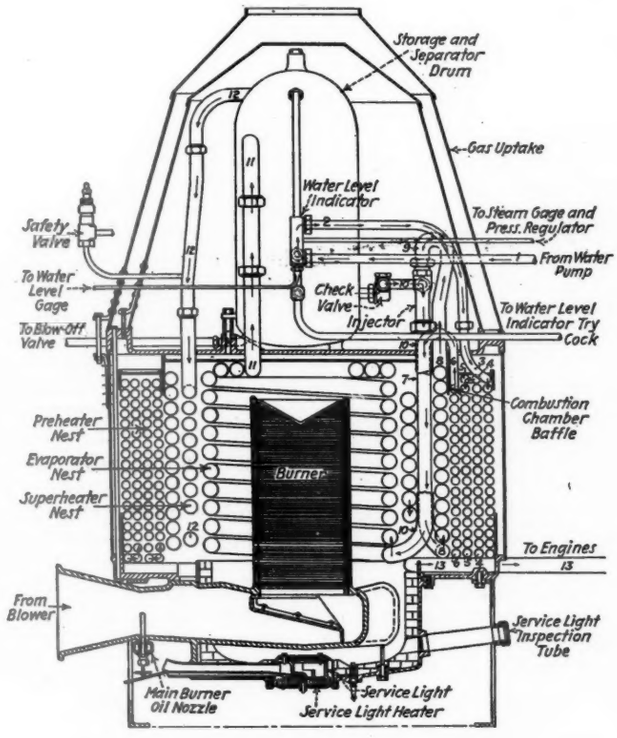
As the water in the system becomes depleted, the lowering of the drum water level increasingly exposes the mercury terminal to steam which can be condensed but not cooled by the feed-water circulation. The increasing temperature from this steam is registered on the thermometer dial outside of the generator compartment. This dial controls an upper and a lower light in easy view of the driver. Both of these lights are burning dimly during operation with full water content. When water depletion has exposed the mercury terminal to steam, the upper light goes out and the lower one brightens.

When the light indication shows water depletion, the driver, by turning a small raw water control, can add sufficient water to the system to restore the level in the drum to its original altitude. When this has been done, the indicator will again register normal by burning both lights.

The entire design has been worked out to bring the cooler gases in contact with the tubes containing the cooler water, and the hottest flame and gases in contact with the tubes containing the hottest water and steam.

The progress of gas temperature from high to low, as the outside of the cylindrical steam generator is approached, together with the use of the surrounding heated air to supply the blower, makes for an efficient unit and avoids the necessity of providing an insulated jacket enclosing the generator.

The condensers, located on the roof at each end of the car, are composed of several cores connected in series of pairs, all cores being positioned so as to be self-draining with no valves or cut-out cocks. At the



Cross section of the steam generator

head end, the air enters horizontally through the tunnel beneath the condensers and passes upward through the cores. At the rear end, it is sucked downward through the cores and leaves through a similar tunnel. In cold weather, the air pressure from the movement of the unit accomplishes condensation. For warmer atmospheric temperatures, three specially designed reversible fans are provided at each end to increase the air circulation as required.

Compact engine design

The high steam pressure used in this car makes possible a powerful but compact engine design. The two eight cylinder uniflow single-acting engines are of the single-acting poppet valve type, located underneath the car where they are easy of access.

Typical sections of the cylinders and crank case are illustrated. The steam from the admission manifold is conducted to the cylinders through poppet valves. The wheeled stems of these valves are positioned on the cam shaft. The cam shaft is shifted longitudinally by the movements of a notched shaft, which is controlled by the reverse lever. There are seven notches in the shaft into which a spring pawl fits and holds the cam shaft securely in position except when forced on to another notch by the operation of the reverse lever.

When the pawl is positioned in the central notch, the wheeled stems of the valves are resting on the round sections of the cam shaft and the admission valves are firmly seated, admitting no steam to the cylinders. This is the position used when the unit is drifting.

When the notched shaft is shifted one notch ahead it places beneath each valve stem a cam which will open the admission valve for 15 per cent of the piston stroke. Shifting one notch backward provides a similar 15 per cent cut-off in reverse. Shifting two notches either way from the center provides a 25 per cent cut-off forward and reverse. Three notches provides a 75 per cent cut-off in either direction.

The camshaft is geared to the crank shaft with one idling gear intervening. The idler gear is of unusual width to permit shifting the entire cam shaft and its attached gear without unmeshing the two gears.

It will be noted that only a plain flange guide is provided for the piston rod, the single-acting type making it unnecessary to provide piston rod packing or contend with piston rod packing troubles.

An oil pump, located inside the crank case, forces oil to the crossheads and the main and connecting rod bearings of the crankshaft, all parts, including the cylinders, being lubricated by force feed. The recovery of practically all the oil carried away as vapor in the exhaust confines oil consumption to the small quantity used directly for lubrication of moving parts. The oil separator, of the DeLaval centrifugal type, consumes about ¾ hp. at operating speed, and is estimated to reclaim 98 per cent of the oil in the condensate.

The driving shafts are especially designed of alloy steel, heat treated. To accommodate variations in truck positions, the shafts fit into splined sleeves and have a universal joint at each end. The connection between the drive shaft and axle is accomplished by means of bevel gears with constantly changing tooth contact, enclosed in a cast steel, oil tight gear case.

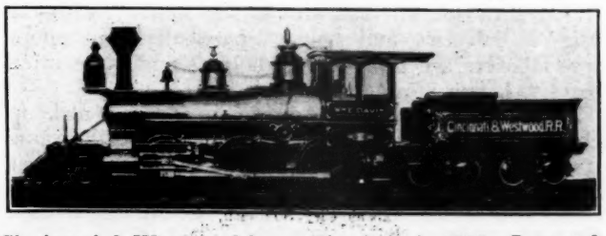
The trucks are of the 4 wheel equalized type, with Commonwealth cast steel frames and swing bolsters, and 36-in. rolled steel wheels with Simplex clasp brakes. Plain journal bearings are provided on the car illustrated.

Braking power is furnished by a General Electric electric-driven air compressor and Westinghouse equipment, including a 16-in. brake cylinder and triple valve.

It is claimed that, in addition to affording a clean, silent and reliable transportation power operating efficiently with a low priced liquid fuel, the Locomotor power plant is of substantial design, conducive to long life and freedom from breakdown. Maintenance cost is expected to be kept at a minimum by the closed system of lubrication, the simplicity of construction and consequent low cost of repair parts.

It is understood that this type of power plant is next to be introduced in a switching engine for service requiring up to 1,500 hp. in districts where it is desirable to eliminate noise and smoke and still avoid the installation of expensive electric transmission lines.

The manufacture and sale of the Locomotor will be handled by the Railway Locomotor Company, Chicago, a subsidiary of The Ryan Car Company.



Cincinnati & Westwood locomotive built in 1876—Gage, 3 ft., cylinders 11 in. by 16 in., diameter of drivers, 36 in.

Determining the Fitness of Employees*

Men should be selected, not alone for today's job, but as potential material for supervisors and officers

BROADLY speaking, the entire subject may be summed up in the words of a mid-western railway official who said, "We are endeavoring to make our road a difficult one to get work with, but an easy one to work with after getting on." In other words, thorough and intelligent employment and placing procedure on that road is making a better, smoother and more efficient mechanical department.

It might be well to first consider some of the things which bear relationship to the employment and maintenance of a force of workmen. Among the myriad of things affected by the world war were railroad shops. Wages in other industries rose so sharply above those of the railroads, particularly in the large industrial centers that it was a difficult problem to man the shop with numbers, much less efficient mechanics. Since the war, industries have further consolidated and gigantic combines have taken thousands of railroad trained mechanics. We are informed that such a condition prevails today in the large industrial districts. On the other hand, the midwestern and western roads have had a plentiful supply of all kinds of workers.

Permanency of employment

The old time gypsy of the railroad game, the boomer mechanic, belongs to an almost extinct race. Railroad men in the country over are settling down to permanent employment. On a number of railroads in this country, there is no problem of employing mechanics. Awakened interest in apprentices and better training methods is the order of the day. The days of McAdoo are past and there is an ever increasing demand for fully trained mechanics such as up to date apprentice systems produce. Such railroads as the Santa Fe, M-K-T, K. C. S. and others are not employing mechanics from the outside except in very rare cases. Thus the problem of actually selecting mechanics starts with the employment of laborers, helpers and apprentices.

L. W. Baldwin, president, Missouri Pacific, in addressing the A. R. A. Convention on the subject of Training Shop Supervisors said in part: "It is an accepted fact that the problem begins with the selection of the apprentice. An apprentice should have at least a fair elementary education and something of his habits, inclinations, personality, home life and surroundings should be known to the employing officer, as every care should be exercised in selecting apprentices."

Quality to be desired

What Mr. Baldwin has said is also applicable to the hiring of laborers and helpers particularly in shops where laborers are promoted to helpers and quite often helpers to helper apprentices.

The things we ordinarily desire in a man's makeup such as character, honesty, ambition, etc., are the same for mechanics and apprentices. The difference is that we do not expect an applicant for apprenticeship to have the experience and trade knowledge of a journeyman mechanic.

Let us examine for a moment the usual methods used in selecting apprentices. On those roads which have no regular system of apprentice training, personal friendship or "drag" is the determining factor as it is not necessary to pass any mental examination and quite frequently even physical examinations are omitted. Apprentice training courses definitely require a sound body and certain amount of schooling. Ordinarily the applicant must be able to work certain arithmetic problems and perhaps to write and spell correctly.

Such examinations we have all taken in our school days. These examinations required correctness with little regard to the amount of time consumed in writing the examination. There was no premium on being able to do the assignment quickly. A slow methodical student would perhaps make as good a grade as the more alert student.

In addition to good physique and character we look for a sound intelligence and mental alertness on the part of the applicant. A boy in the formative age who is possessed of an average amount of intelligence and who is alert mentally can be moulded into almost any position we desire. Then how are we to determine if a young man is a quick and accurate thinker?

Mental tests are the most accurate guide

About 300 years after that famous Greek philosopher, Aristotle, wrote a treatise on the theory that one's nature is paralleled by physical characteristics, Julius Cæsar, in analyzing the character of his friend Cassius, associated a lean and hungry look with a tendency to think too much. Up to the present day those who believe that character can be read by studying physical characteristics have followed the reasoning of Aristotle. Many conclusions have been drawn from studying animals. They assume that since a lion with coarse hair and blue eyes is courageous that human beings with the same characteristics are endowed with much courage. We hear of the thick lips of sensuality and the high brow of the scholar. All of these things brought down through history and used by nearly all writers in their delineations of character have become so commonplace that most of us believe in this theory.

The average individual more or less unconsciously believes that he can size up a man quite accurately by his personal appearance and through a few minutes of conversation. If this were true there would be no misfits in this world and each organization would be one of machine-like perfection. Science and long investigation has shown us that there is little connection between mental and nervous make-up and physical characteristics.

The study of psychology, a rather big word which describes the science of the human mind and its powers, operations and functions, has convinced many investigators that the only one way to test the functional powers of the brain is by actual examination. Just as one's

*An abstract of the report of a committee, of which C. Y. Thomas, supervisor of apprentices, Kansas City Southern, was chairman, presented at the recent convention of the International Railway General Foremens Association held at Hotel Sherman, Chicago.

strength would be tested by determining how much weight he could raise, so the brain is tested to determine how quickly and accurately one can think.

There have been developed and are being developed all kinds of psychological tests which aim to determine many things such as general intelligence, mental alertness, will power, mechanical aptitude, etc. The use of these examinations in determining the characteristics of applicants for employment is spreading amazingly and extensive usage is being made by such companies as the General Electric Company, the Yellow Cab Company, many others and the U. S. Government.

Mentally alert employees

In the selection of mechanics, helpers, apprentices and laborers, every employing officer should make an attempt to get mentally alert employees. By using a standard mental alertness test or general intelligence test, this characteristic of the applicant can be found. One of the standard mental alertness tests can be given in either 20 minutes or 30 minutes and as it is practically self explanatory, the administration of such a test takes not more than two minutes of the employing officer's time. A clerk can readily give the examination.

On a certain eastern railroad, the general manager is giving this test to several classes of employees, particularly brakemen, firemen, office employees and civil engineering department employees. A minimum grade has been set up for the various classes and an applicant must make a passing grade.

One of the southwestern roads has been experimenting for two years with its apprentices in ten different trades. The first experiment was to have the various foremen rank the apprentices in the order of their intelligence. This was followed by giving a standard intelligence test to all of the apprentices. After grading the examinations, they were ranked in the order of highest to the lowest grade. When the foreman's estimate list was compared with the test results, there was a correlation of almost 80 per cent. In short, the test showed in 30 minutes what the foreman had learned about the boys after one, two or three years' association.

A second experiment was to keep a close record of those apprentices who failed to make a normal passing grade. After two years close observation in the shop following the tests, not one of the nine who failed the test gives any promise of ever being an intelligent mechanic.

A third experiment was to keep tab on the highest 10 per cent to see how they turned out. The 10 per cent was a group of nine apprentices, all but two of whom have since completed their apprenticeships. Two of these young men are now salaried piece work checkers while all the others are successfully holding journeyman jobs.

The conclusions drawn from the experimental test indicate that the test very successfully predicts or rates the mental alertness of the applicant which can otherwise be determined only by some months or years of close association. Thus we have a means of quite accurately determining the mental workings of a complete stranger.

The ability of mechanics should be determined

An applicant for apprenticeship who can successfully pass the mental alertness test and who is sound physically has the background for success and is likely to get ahead unless influenced too greatly by outside interests and a low grade environment.

Laborers, helpers and mechanics should be given an intelligence or mental alertness test and with respect to mechanics a trade test should be given which would definitely indicate that the mechanic possessed the trade knowledge necessary. Such a trade test would serve a dual purpose; it would assist in picking out the best man if there were several applications for the job, and secondly if there was but one applicant for the job it would quickly show up if the applicant was an impostor.

The committee was unable to find where a test for trade knowledge had ever been developed for any of the common railroad trades such as machinist, boilermaker, carman and the like, and it was intended that some trade tests be made up, testing the examination on several railroads with mechanics of known ability. This, however, was more of a task than the committee found it could assume.

It is entirely possible to work up a trade knowledge test which can be given in half an hour and can be administered by a clerk. Such a test together with a mental alertness test should give an employing officer a very definite idea of the man's ability.

Let us consider for a moment two methods of hiring a new machinist. The applicant comes into the general office and applies for a job and first answers questions as to where he had worked before. The general foreman then asks if he is a machine man or floor man. If a floor man is wanted and the man says, "Sure I'm a floorman," the average general foreman tells him to go get fixed up and come in in the morning. By this method the foreman is really in the dark as to whether or not the man is what he claims to be.

Now another method. The general foreman tells the applicant for a job as machinist to see the clerk. The clerk gives him two written examinations requiring not over an hour for both of them and after grading the papers hands them to the general foreman. If the grade is too low, the clerk dismisses the man and if a good grade is secured, the foreman can interview the man very intelligently. Doubtless you will all agree that the latter method saves much time which would be wasted in interviewing unfit applicants. Only those who appear worthy are permitted to take up any time. Another feature of this method is that the chances of getting a man who is unfit are very much lessened. Under the old method, it took some time, perhaps a week or more to discover that the man was not what he claimed to be. Breaking in new men is a costly process.

The problem of physical fitness

Now let's consider another side of the human being, his physical characteristics. On most roads, the working agreements stipulate the age limits so that if the mental working of the man is satisfactory and he is within the age limits, about the only thing remaining to be studied is his physique.

Practically all railroads require physical examinations of new employees in all classes of shop and road service employees. It is charged that this is done more to prevent fraudulent injury claims than for any other reason. In other words, neither employing officers nor their medical friends are making the most of a physical examination with respect to interpreting the results. The average physical examination determines the condition of the applicant with respect to eyesight, hearing, heart, hernia, susceptibility to disease, etc., but there is no measure of the stamina of the applicant. Just as the requirements of a job differ so may the physical characteristics of the man on the job differ.

There are no really good reasons why a man with but one arm should not be employed as a gate watchman, nor why a man with a finger off should not be employed

as a painter. A foreman should not only study the results of the physical examinations, but should make sure that the man has the general physique to hold the job. A case comes to mind where a boy weighing 112 lb. was employed as a boilermaker apprentice. It was soon discovered that he couldn't "stand the gaff" and within six months he was told to resign.

The average doctor has no knowledge of the requirements of a certain job with respect to the physical condition of the applicant. A 99 lb. man may pass an excellent physical examination and be approved by the doctor for a job as blacksmith's helper. Our common sense tells us that this man would not succeed in this work. Thus a foreman should exercise care in employing men for jobs where strenuous work is the regular order of things. It might not be amiss to set up minimum weight and height limits for various occupations. A case is on record where a bright machinist assigned to a heavy duty lathe was unable to make his piece work rate. It did not take long to discover that his height of five feet four inches prevented him from quickly reaching the control levers, and from readily caliper-ing the work in the lathe.

General foremen who are not closely studying the physical examination report of a prospective employee are neglecting their full duty in hiring him. It is earnestly recommended that all shop employees, apprentices, helpers and mechanics be given a thorough physical examination before employment not only to protect the employing company from fraudulent injury claims but from an equally important standpoint of placing a man where he can best deliver a full day's work in a regular manner.

The selection of men for promotion

The subject of selecting men for promotion is similar to that of selecting the workmen themselves. When the basic material is good, leaders just spring out entirely uncalled for. However, a foreman should have certain features or characteristics above those of a good workman.

A foreman must have good health, be intelligent, have a natural aptitude for his work and for handling men and lastly must be possessed of a fair education, interpreted in the broad sense of schooling together with practical knowledge and training.

The question is how to determine these attributes accurately so that men may be compared and naturally the best man selected for the position.

As Mr. Woodruff of the Erie says, "Human nature can be measured and classified just like any other quality or quantity. But in doing this, we must use our intellects rather than our emotions." The average man is prone to overlook the faults in his friends and at the same time be too critical of lesser acquaintances.

One fault to be found in the ordinary selection of a man for a foremanship, is that the man is selected for the immediate job and no thought given to his capability for advancement above that particular job. For instance in selecting a roundhouse gang foreman, a selection should be made with a view towards his being a roundhouse foreman, a master mechanic, or a mechanical superintendent. In order to determine these abilities, a combination of studies should be made of those thought to be ready for promotion.

From their personal records we can determine age, schooling, experience, business connections, correspondence courses taken or other efforts towards self-advancement.

Then from the opinions of the various foremen and supervisors it is possible to learn the ability of the candidate for promotion as a mechanic, his mental attitude towards his work, his loyalty, his ability to get along with men. A close study of the opinions of the supervisors who have known him for some time, together with a close scrutiny of his personal record file should determine the most eligible candidate. This method has been the one in general use for years and is good except where selection has been made on personal friendship or the connections of the man involved.

Today, railway officers are demanding something more of the men they promote, because they are becoming more active unofficial ambassadors in their respective communities. They want men of character, of pleasing personality and unquestioned honesty and loyalty.

And then, realizing that it is much harder to be a successful foreman than it was some years ago, they want men of sound intelligence and a capacity for learning and for assuming responsibility. In short, foremen must have improved mental makeups. It is indeed a difficult matter to determine even through close association with an individual just what his mental alertness is. We are, however, indebted to industrial psychologists for all kinds of examinations to determine intelligence, mental alertness, etc. It is not for us as railroad men to say that this test or that, is or is not the proper one for us. However, if a group of tests is used and the results tabulated, the managing officer should have some reliable data to assist him in selecting his foreman. It is said that grown men make light of so called fancy psychological examinations, but if the truth were admitted they shun tests because they fear the results. No doubt a test could be made up for common items in various trades, bits of general railroad information, etc., which would quickly reveal the effort an individual is making to secure advancement.

Thus we recommend a broad manner in selecting new foremen, composed of three divisions:

1.—Study of the man's personal record.

2.—Study the opinions of several supervisors who know him.

3.—Determine his intelligence and mental alertness through examination.

In recent years, a regularly constituted personnel department has taken its place on a great many railroads. One of the functions of this department is to pass upon the new men hired on the application for employment. General foreman should take advantage of any assistance offered by the personnel department.

It is too much for a general foreman to tell whether a man is entirely honest, is a good man morally and all that, from an interview. The personnel department attempts to secure this information through the associates and reference of the applicant. The time and trouble taken to insure that the new employee is satisfactory in all respects is expended to good advantage.

The personnel of railway mechanical departments will improve just as rapidly as employing officers take the trouble to select better men. In order to assist in selecting these men, the committee recommends the adoption and usage in some manner of these things:

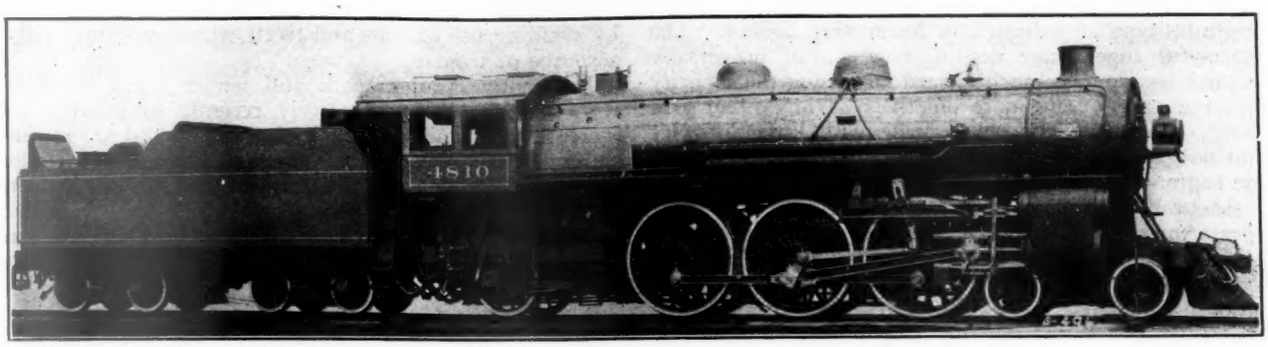
1.—Physical examinations for all classes of mechanical department employees except office forces.

2.—A better interpretation of physical examinations to assist in placing a man on a job properly.

3.—A general intelligence or mental alertness test for laborers, apprentices, helpers and mechanics.

4.—A trade knowledge test to prove conclusively that applicants for a mechanic's job have a good working knowledge of the trade.

5.—A thorough and definite system of finding out characteristics of the applicant not determinable through interview or examination.



A 4-6-2 type passenger locomotive built in **1907**

Cylinders, 22 in. by 28 in.; Diameter of drivers, 79 in.; Boiler pressure, 200 lb.; Tractive force, 29,200 lb.; Total weight, 261,000 lb.

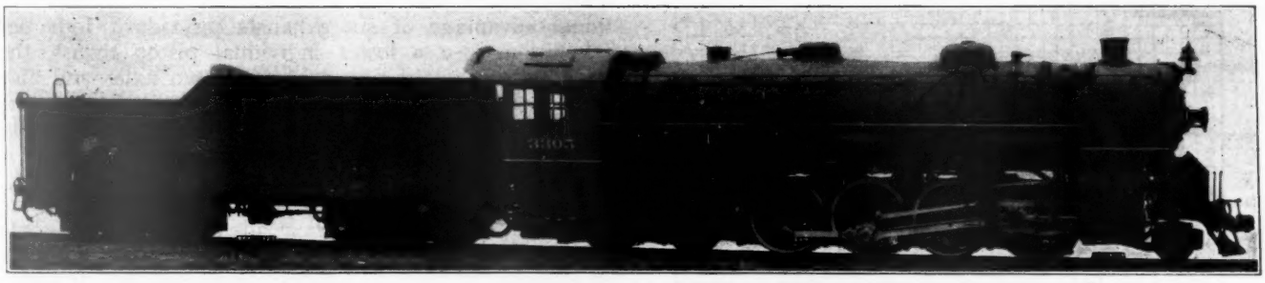
The locomotive yardstick*

Indicated horsepower is the true measure of work performed—Locomotives should be proportioned to meet requirements

By A. W. Bruce

Designing engineer, American Locomotive Company, New York

FROM 1900 to perhaps 1905, we saw the gradual abandonment of the various types of compound cylinders, in favor of the two-cylinder simple arrangement for single unit engines. The compound remained on Mallet types for which it was particularly adapted and has continued until the present time, although recently it is being superseded by the four-cylinder simple type. This was not due to any particular error in the compound principle as applied to locomotives, but to the fact that fuel was relatively cheap and to use straight mud rings, with ample depth of throat; provided us with sufficient depth over the fire, with proper combustion volume, and in fact gave us an elasticity in boiler design never before reached; it permitted us to use practically any size of boiler desired or any size driving wheel, and to obtain a comparative increase in boiler capacity with relation to cylinders, with consequent sustained capacity never reached before. We also see a return of the combustion chamber with the use of the trailer truck, in fact, it would almost be impos-



A 2-8-4 type freight locomotive built in 1927

Cylinders 28½ in. by 32 in.; Diameter of drivers, 70 in.; Boiler pressure 225 lb.; Engine tractive force, 70,000 lb.; Booster tractive force, 11,700 lb.; Total tractive force, 81,700 lb.; Total weight, 443,000 lb.

the maintenance cost of the compound engines overcame the difference in economy. Perhaps if present day superheaters had been in use, we should have had another story. With the constant increase in demand for more power, together with the use of poorer fuel, the narrow firebox was quickly superseded, just as soon as it was found that wide fireboxes could be successfully applied.

The introduction of the two-wheel trailing truck constituted one of the most important steps forward in locomotive design because it immediately removed all restrictions from proper firebox design; it gave us a chance sible to build some of our present large size boilers without its use, on account of the abnormal length of tubes which would otherwise result.

Soon after the adoption of the trailer truck, we find the use of outside valve gears becoming general. We were forced to this owing to the increased size of the eccentrics, straps, rockers, etc., which rendered the parts inaccessible and weak for the work they had to do. The outside valve gear permits accessibility and lubrication, at the same time giving us a chance adequately to brace the frame together.

Ranking in importance along with the introduction of the trailer truck comes the application of the present

* Abstract of paper presented at the November 21, 1927, meeting of the Western Railway Club, Chicago.

fire tube type superheater in locomotive boilers. The successful superheater design, now almost universally applied, has done as much toward increasing the capacity and economy of steam locomotives as any other one thing. Its introduction was made with little difficulty and no great change has been made in its design from the beginning.

About 1913 the late F. J. Cole, chief consulting engineer, American Locomotive Company, introduced one of the most important changes in the method used for locomotive proportional design which has yet been brought forward. It was the first rational step toward the rating of locomotives and deciding on ratios before the building of the actual machine. It has remained unchanged and is almost universally used at this time. It consists in the rating of the cylinder power on a maximum indicated horespower basis; and the rating of the boiler on an evaporation basis obtained from arbitrary evaporation figures for both the firebox and the tubes, together with an arbitrary maximum figure for coal consumption per square foot of grate area.

About this time much more general recognition was given to the control of lateral motion on curves. Heretofore about all that was considered necessary, was that the locomotive pass through the given curve without derailment. Many well remember the trouble experienced with frame breakage, especially on 4-6-0 type locomotives between the cylinders and the first drivers; much of this could have been obviated if we had known then what we know today about truck resistance and the guiding of locomotives. In providing guiding power on trucks, truck wheel flange wear is to be expected and is a sign that the truck is doing what is expected of it; it is much cheaper to turn truck wheels than driving wheels.

Development of boiler accessories

Locomotives were now becoming of such size that it was hard for one man to handle sufficient coal. Me-

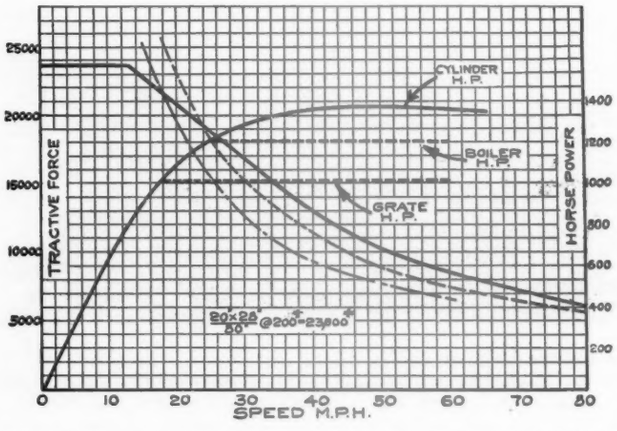


Fig. 1—Characteristic curves of a 4-6-0 type locomotive built in 1900

chanical stokers began to appear, passed through a period of development and have now assumed their proper place. It would be impossible to produce anything like present horsepower figures continuously without this device. Its adoption has also permitted possibilities of using a much poorer grade of fuel than could otherwise be handled.

While affecting chiefly maintenance, we should mention the increasing use of integral cast steel details, such as truck frames and also complete tender frames, thereby avoiding use of bolts and rivets which are continually a source of trouble.

Locomotive trailer truck and tender truck boosters were introduced comparatively recently to provide an increase in locomotive capacity in starting and to prevent stalling. This device was very well named and should be used accordingly for best results. We find further developments in boiler accessories which have resulted commercially in feed water heaters and in firebox siphons, both of which are becoming quite generally used.

The increase in permissible driving axle load has been comparatively slow, and in order to get the maximum

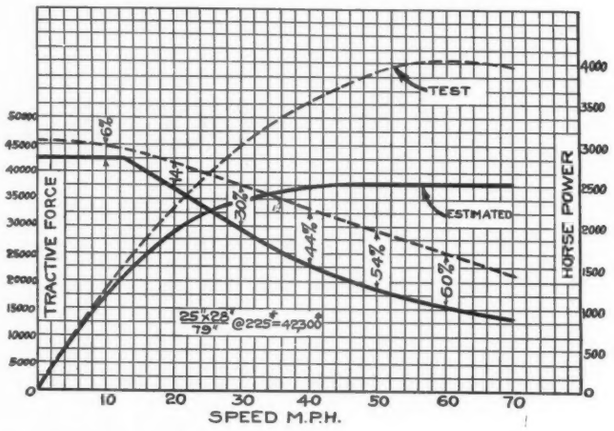


Fig. 2—Characteristic of a 4-6-4 type passenger locomotive built in 1927

amount of tractive force out of a given weight on drivers, which may be done with a more even starting torque, two modifications in locomotive practice have appeared. They are the limited cutoff two-cylinder locomotive, which has necessarily the added advantage of steam economy due to expansion when used continuously and in slow speed operation. The other is the three-cylinder principle which carries with it the additional advantage of six exhausts instead of four per revolution, also a lower individual piston thrust, the possible division of power between two axles and also the possibility of all the economy obtained through the limited cut-off feature which may be applied equally well on three as on two-cylinder locomotives.

Gradual adoption of high boiler pressures

At the present time the railroads are gradually adopting the use of higher boiler pressures. This gives us an economy in fuel and a quick, smart engine. It keeps the cylinders and reciprocating weights within reasonable limits but does, of course, require more careful boiler construction, suitable boiler fittings and pipe connections.

Following the increase in boiler pressure, the railroads are developing gradually the water tube type of firebox. The older stayed plate firebox is apparently only suitable for pressures not exceeding approximately 300 lb. per sq. in. Water tube fireboxes are in use in this country up to 400 lb. pressure and abroad in excess of 800 lb.; just what the final limits of pressure or of design will be is not yet known.

European development has gone so far as to include not only poppet valve cylinders but also turbine locomotives with condensers and with either electric or gear drive. This type of machine is still in the experimental stage and I see no hope for its introduction in this coun-

try for general use until the first cost, total weight per horsepower, mechanical difficulties and maintenance cost have been greatly reduced, and reliability in service assured.

The result of all these developments, both in design and in operating conditions, has been a unit of steam motive power having high general efficiency, together with high sustained horsepower. It follows, then, that the introduction of a given number of modern steam locomotives in main line service will automatically retire a greater numerical number of locomotives previously in use, to service on lines of secondary importance. This is a condition which quickly results in a

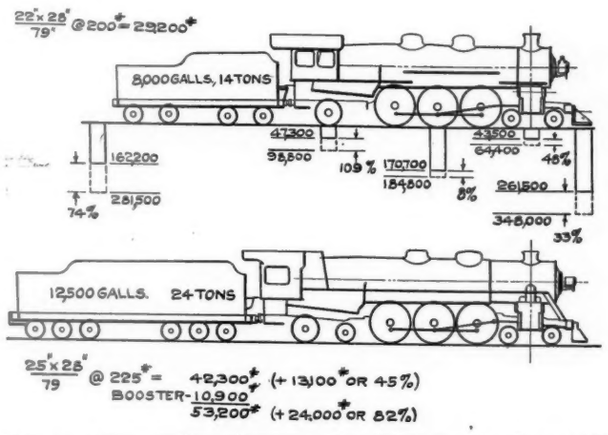


Fig. 3—Comparative diagrams of a 4-6-2 type built in 1907 and the 4-6-4 type built in 1927

surplus of obsolete power which the railroads cannot afford to operate, in view of the economies obtainable through the operation of modern equipment.

The constantly increasing use of motor trucks, motor buses and motor rail cars, together with the discontinuance of many branch lines, tends largely to remove the only available chance which we had to obtain further mileage from this obsolete class of power.

The locomotive—A direct producer of revenue

As a railroad is nothing more than a commercial manufacturing plant, whose only product is transportation, and in which the locomotive is the only direct revenue producing unit, it immediately becomes apparent that we must apply the same rule for economical production to the railroad that we would apply to any commercial plant. We all know that the success of present day industry has been due to large production at low unit cost. The sooner we learn to apply this to railroad operation and the sooner we make up our minds to scrap obsolete power and to substitute new power of modern design the sooner we can hope to pay suitable dividends on our initial investment.

I realize perfectly the enormous amount of capital represented in motive power equipment. What other manufacturing industry, however, could be carried on competitively, using continuously machines 20 to 25 years old in the manufacture of its product?

Retiring first line power

There is also the danger that in retiring first line power to secondary lines, we will have an uneconomic operating unit. Locomotives, like any other machine, must be designed for their particular service in order to produce the best returns.

The importance of doing just this thing becomes more obvious, when we realize that we are still operating many locomotives in service, which average little better in performance than some of the locomotives built about 25 years ago. From a strictly modern locomotive having the same number of drivers, we might reasonably expect to obtain results something like 3,000 to 4,500 or even 5,000 maximum i.h.p., coal consumption 2 to 3 lb. per i.h.p.-hour, a steam consumption of 17 to 18 lb. per i.h.p., and sustained maximum power at high speed.

The development of passenger power

Fig. 1 shows the characteristics of a 4-6-0 type locomotive built in 1900 that is typical of any narrow firebox saturated steam locomotive. The first dotted lines below the tractive force curve show the reduction due to lack of sufficient boiler capacity. The second or lower dotted lines show the further reduction due to the restricted grate area of the narrow firebox. Fig. 2 shows the result of the development in the three-coupled locomotive design since 1900. The dotted lines show how much by actual test the designers have been able to exceed the old standards through the working range of high speed passenger service. This increase is entirely due to the greater steaming capacity made possible through the application of a larger boiler, mechanical stokers, improved superheater, feedwater heater and other accessories, the additional weight of which is chiefly absorbed by the 4-wheel trailer truck.

Fig. 3 shows comparative diagrams of a 4-6-2 locomotive built in 1907 and the 4-6-4 type built in 1927. We can assume that both types are still in service. Note the comparatively small increase in the weight on the drivers as compared with the increase in the total weight and tractive force. A comparison of the characteristics of the 4-6-2 and 4-6-4 types, the diagrams of which are compared in Fig. 3, are shown in Fig. 4. The wide gap between the tractive force and the indicated horsepower

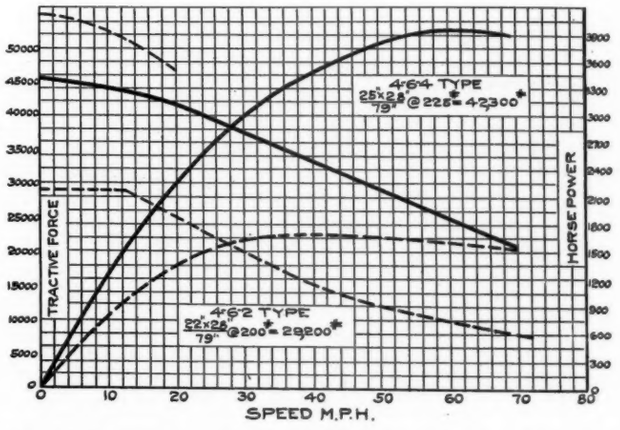


Fig. 4—Comparison of the characteristics of the 4-6-2 and 4-6-4 types shown in Fig. 3

curves for these two locomotives, represent just one thing; namely, power output at speed.

Development of freight power

In the 2-8-0 type built in 1912, we see this type of locomotive developed to its final stage with this wheel arrangement. While it might have been possible to go a little further with this type, its limitations were too obvious to warrant the expense. The 2-8-2 type has been probably the most successful wheel arrangement ever used for all around freight service. It is, however, beginning to fall back at this time because of insufficient boiler capacity. The 4-8-2 type is one of the best wheel arrangements for high sustained power that has been

developed up to the present time. With a wheel diameter to suit, it is readily adapted to either freight or to passenger service. Where exceptional power is required, a four-wheel trailing truck may be used equally well.

The characteristic curves for a typical example of a 4-8-2 type locomotive built in 1927, are shown in Fig. 5. The increase in the tractive force and indicated horsepower cylinder curves, as shown by the dotted lines, taken from actual test data, is due entirely to greater steaming capacity.

Fig. 6 shows the comparative diagrams for a 2-8-2 type locomotive built in 1913 and a 4-8-2 type built in 1927. These diagrams are representative of the majority of Mikado type locomotives operating daily over the railroads of this country. Note the results in tractive force that have been obtained with the increase in weight of 13 per cent on the drivers.

The comparative characteristics of the locomotives shown in Fig. 6 are plotted in Fig. 7. Again the difference between these two locomotives represents capacity only. The final result in the case of freight locomotives is measured in ton-miles instead of in the number of cars in a train as for passenger locomotives.

The yardstick versus the two-foot rule

The modern locomotive is still subject to the two-foot rule requirement of tractive force for starting trains. Beyond this point, however, we apply today the yardstick of indicated horsepower which is the true measure of work performed by any prime mover, no matter what form it may take. This same horsepower unit appears again under the name of "gross ton-miles per hour," along with the corresponding measure of locomotive efficiency—"coal per thousand gross ton-miles."

The difference in the two standards of measurement is perfectly simple. The older tractive force standard is indefinite, as it makes no allowance for time or dis-

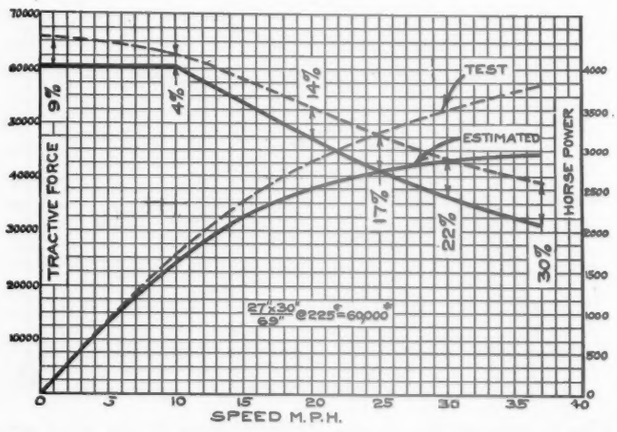


Fig. 5—Characteristic curves for 4-8-2 type locomotive built in 1927

tance. The modern standard is both accurate and definite, in that it defines a certain amount of work to be done within a certain definite period of time. The definition of the term horsepower is "a unit of measurement for the rate of doing work." The importance of measuring locomotives by this standard will appear from the following actual returns covering two types of locomotives on a western road.

Because of profile limitations this railroad had been using 2-8-8-0 type Mallets and had considered them very satisfactory until receipt of some three-cylinder 4-12-2 types of about the same tractive force. The Mallets were considered one of the best successful designs in its class for use over an undulative profile, until operating speeds increased to a point beyond its limit. The three-cylinder 4-12-2 type was designed to handle the same tonnage at much higher speeds. While this locomotive has a 30 ft. 8-in. driving wheel base, the front and rear axles are arranged with lateral motion devices, enabling it to pass road curves without difficulty. In actual service on 1½-per cent grades, the 4-12-2 type has handled the same trains as the Mallet, at higher speeds and with less coal.

On 0.8 per cent grades the 4-12-2 type shows 80 per cent more ton-miles per hour on about 50 per cent of the Mallet fuel consumption per 1,000 gross ton-miles.

Another more recent striking example is that of an

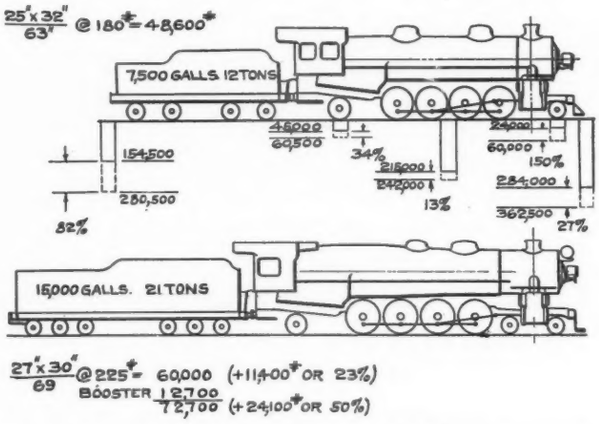


Fig. 6—Comparative diagrams for a 2-8-2 type locomotive built in 1913 and a 4-8-2 type built in 1927

eastern road, which received in 1916, for use over a difficult undulating division some of the largest and most powerful 2-10-2 type locomotives, built up to that time and which were continued in service until the receipt in 1927 of some 2-8-4 type locomotives. These were equipped with trailer truck boosters and have approximately the same tractive force, in spite of the fact that the driving wheels are 70 in. instead of 63 in. in diameter.

With a slight increase in axle load these 2-8-4 locomotives have more heating surface and grate area than the 2-10-2 type. They are fully equipped with modern accessories, including large capacity tenders. These locomotives have extremely large size boilers, which act as power supply reservoirs in overcoming service fluctuations to the extent that steam failures are unknown. To those who have attempted to keep the gage pointer one or two pounds under popping, this may sound almost too good to be true. It is, however, made possible on this type by absorbing the extra weight of the large boiler on the four-wheel trailing truck.

That these locomotives are justifying their selection is apparent from the following figures. Operating over an undulating division, a little over 100 miles in length, with a 1.14 per cent ruling grade, averaging for each type five trips east and five trips west bound, preliminary tests have shown results in favor of the 2-8-4 type to be as follows: an increase in actual tonnage of 10 per cent, a saving in running time of 35 per cent and a saving in coal of 30 per cent for 1,000 gross ton-miles.

What represents modern practice in locomotive design?

Operating experience has shown that, for the comparatively high speeds and high axle loadings common

at this time, both for freight and passenger service, four coupled axles are in general sufficient to take care of two simple cylinders without excessive wear and tear. We have many five coupled axle engines in service at conservative speeds, but, with a few exceptions, their use is less common today than it was 10 years ago, owing to the relatively high cylinder thrust and reciprocating weights required for five axles. A good many roads have felt that for five axles connected together, it was safer to go to three cylinders in order to obtain reduced thrust and reciprocating weights, especially as this arrangement readily permits a division of power between

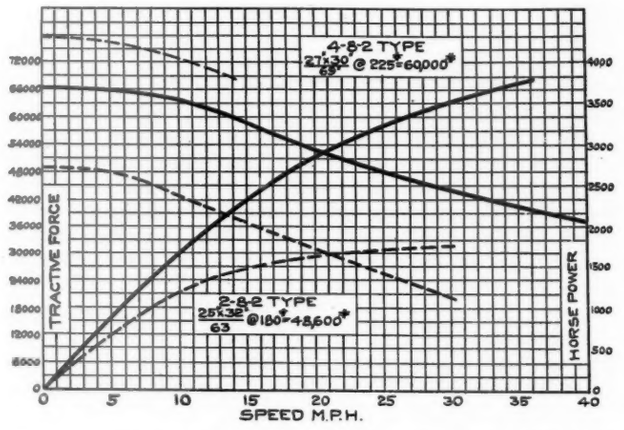


Fig. 7—Comparative characteristic curves for the locomotives shown in Fig. 6

two axles. With six coupled axles there are very few of us who would attempt to maintain the two cylinder principle and, in fact, it would be almost impossible to hold the enormous thrusts and to counterbalance the wheels.

The general design has, then, taken the form of a two-cylinder simple locomotive for road service, in general with either three or four coupled axles (most passenger locomotives still having three axles), with either two or four-wheel leading and trailer trucks. For the higher powers, three-cylinder engines with either five or six coupled axles and provided with suitable lateral motion features to take care of curvature. For extremely high powered engines the four-cylinder simple Mallet is again receiving attention and several remarkable designs have recently been built with a 2-8-8-2 wheel arrangement.

Increase in driving wheel diameter

There is one other point which marks a distinct step forward in the design of fast freight service locomotive and that is the increase in the size of the driving wheel from 63 to 69 in. There is no other single step, with the possible exception of increasing the relative boiler capacity, that has done so much to increase the available ton-miles per hour, and to decrease the locomotive maintenance, because of the decreased number of wheel revolutions, decreased piston speed and better counterbalance conditions. You will readily see that the 69-in. wheel adapts itself for use with four-coupled axles without difficulty, with either two or four-wheel trucks to suit conditions. In all probability the demand for increased boiler capacity will see an increase in the use of the four-wheel trailer truck. Certainly our experience so far has justified this prediction. The locomotives so arranged have ample steaming capacity, good riding qualities and at the same time reduce the rail stresses on the track, by decreasing the distance between individual axles.

The 4-8-2 type with 73-in. or larger diameter driving wheels has become practically a standard type with many railroads for heavy passenger service where more than three axles are required. Has it ever occurred to you that this same locomotive, but with 69-in. wheels, would make one of the best freight locomotives obtainable for through fast freight service that are now being operated practically on passenger train schedules giving maximum interchangeability of details throughout?

I do not mean, however, that all locomotives necessarily should have 69-in. wheels. There are still many roads on which 63-in. wheels are of ample size, but whenever the speeds justify it, the larger wheel is a paying investment and should be considered as such by locomotive designers.

In the past we have always found that a very good ratio of tractive force to adhesion was one to four. It may be possible under certain conditions to slightly reduce this. But is there anything more aggravating to a train crew than a slippery locomotive, with a heavy train and bad weather conditions? Are not many of the advantages claimed for the slight increase in initial tractive force to be found on paper only?

Effect of idle time on the road

We expect the locomotive to operate over long distances and under all conditions. Its operating cost must then be figured on the same basis and not on an ideal performance, possible only for short test periods. It is not difficult to obtain low coal and water rates under fixed limits. It is quite another thing, however, to maintain these low rates in daily operation under the widely fluctuating loads and speeds met in actual service, for which reason conservative ratios in boiler and firebox design, as well as in steam distribution, often prove the most economical.

We see in Fig. 8 a train chart (time—distance) covering a typical freight train movement, selected at random, over a division a little more than 100 miles in length. The total lapse of time is shown by the upper line in which the offsets show the delays occurring at these particular points. It will be seen that seven hours' total was required to make this run or an average speed of 15 m. p.h. over the entire division. The dotted line shows the actual running time of 4½ hr., or an average speed over the entire division of 25 m.p.h., or an increase of 66⅔ per cent over the elapsed time average.

It will be seen further that out of the running time one hour was taken up in drifting down grade so that the lower line shows the time during which the locomotive was actually working or, in other words, the time during which coal was being productively burned. Note that this time was 3½ hr. only or just one-half of the total elapsed time over the division.

Some delays are unavoidable in many instances and while the case shown is, perhaps, excessive, it is still representative of general freight movement today. As long as we operate under similar conditions to these shown, we must design conservatively and avoid possibilities of undue standby losses. How much coal was burned during these 3½ non-productive hours?

Remember the operating cost is figured over the entire year and not over the test hill only.

We must, then, carefully analyze our operating conditions, proportion our locomotive to best meet these conditions and then decide as to what labor and fuel saving devices we can apply to advantage, bearing in mind that any change from normal design, as well as

the addition of any accessories, means additional first cost and weight. To what extent then will these added costs and weights justify themselves at the end of the year, and to what extent might they have been better used in increasing the size of the boiler itself which still remains the controlling factor in the power output.

It is customary for the railroads at the present time to ask for, and to obtain, delivery on entirely new designs of locomotives beginning from 90 to 120 days after the receipt of the order. How many realize that the number of drawings required for a complete engine and tender design has increased from 353 (or 815 sq. ft.) in 1907 to about 1,109 (or 2,268 sq. ft.) in 1927 and that the number of patterns required has increased from 380 in 1907 to about 534 in 1927 (the above do not include

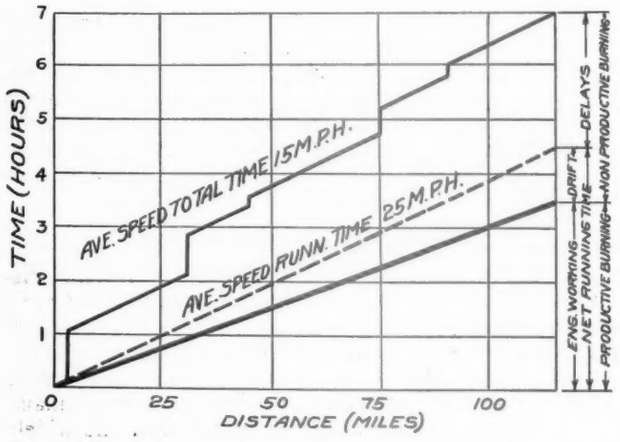


Fig. 8—Time-distance chart for a typical freight train movement

drawings and patterns for dies, templates, etc., which number about 60 to 70 for each, nor does it include the detail drawings for any of the accessories which are quite numerous in some cases).

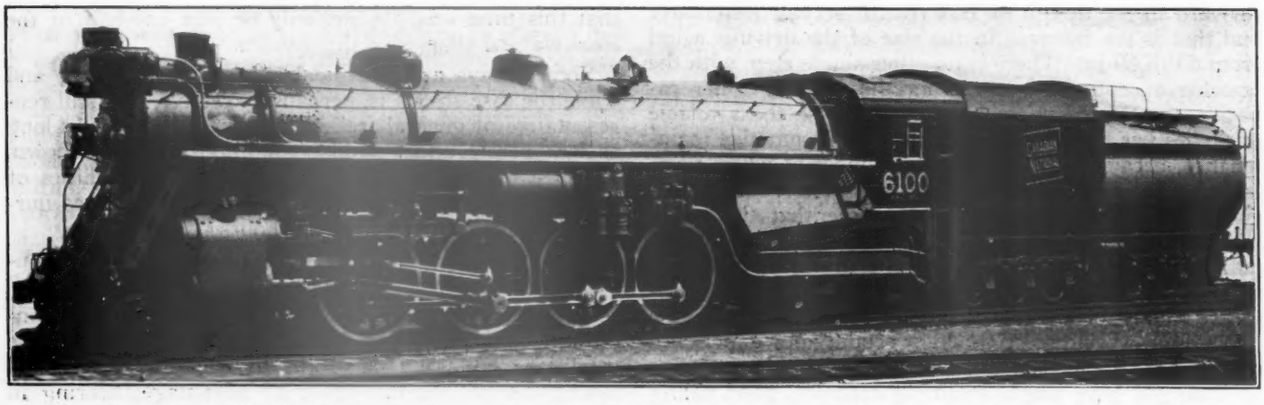
Assuming an order of from 25 to 50 locomotives and an approximate cost of $100,000 each, which is not at all unusual at the present time, an idea is given as to the size of the initial investment on which the railway company expects to make its return. In what other line of industry is an equal expenditure made with so short a time alloted for engineering development? I know of no better way in which the railroads of this country could express their confidence in the ability and co-operation of the locomotive builders.

Discussion

In response to a question by George Goodwin (Chicago, Rock Island & Pacific) Mr. Bruce explained that in developing designs for a new locomotive the builder requires as complete a knowledge as possible of all limiting factors, principally grades, tonnage requirements and speeds, from which are determined the maximum tractive force and horsepower rating of the new locomotive. He said that as many as 1,100 individual drawings, exclusive of accessory details, may be required in developing plans for a new locomotive design. He emphasized again the point brought out in the paper that the requirements of modern railroading call for high sustained power development at speeds which implies boiler capacity considerably in excess of that considered adequate only a few years ago. O. E. Ward (Chicago, Burlington & Quincy) asked about the justification for combustion chambers in boiler design and Mr. Bruce explained that some roads object to combustion chambers on the ground of maintenance difficulties or that they are not needed. In certain boiler designs, however, the inclusion of combustion chambers is practically forced by insufficient combustion space or the fact that without the combustion chamber, boiler tubes and flues would be excessively long. H. P. Allstrand (Chicago & North Western) asked why limited cut-off locomotives are recommended for slow speed service only and Mr. Bruce replied that while there is a theoretical advantage in favor of limited cut-off locomotives over those equipped with conventional valve gears at all speeds, maximum economy is obtained at slow speeds and consequently the best comparative showing is made in this service.

In response to an invitation from the chair, Harry Pflager (Commonwealth Steel Company) explained briefly how tank capacity has been increased without a corresponding increase in the length or height of tenders by means of cast steel tender bottoms, this increase in capacity varying from 15 per cent for six-wheel tenders to 25 per cent for four-wheel tenders. Larger capacity tenders may thus be handled on present turntables. Other advantages of the cast steel tender bottom construction include a low center of gravity, usually rigid construction by means of welded plates and safety by preventing the possibility of the tank being forced into the locomotive cab in case of derailment.

Considerable time was devoted to a discussion of booster application and performance, this discussion being led by J. A. Talty (Franklin Railway Supply Company). Other speakers were C. A. Seley (Locomotive Firebox Company) and R. M. Osterman (The Superheater Company).

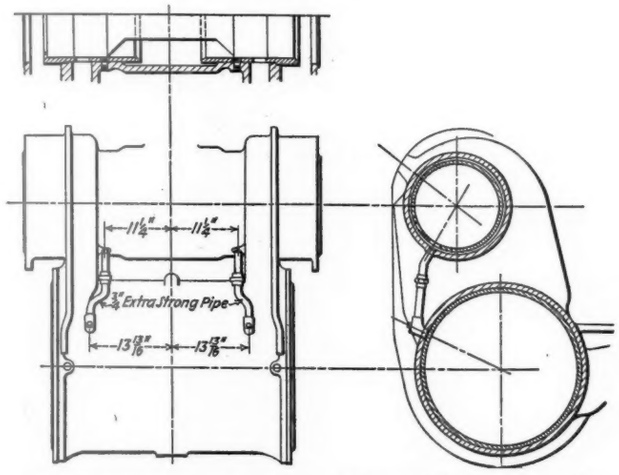


The Canadian National's 4-8-4 type locomotive "The Confederation," on exhibition at the Fair of the Iron Horse

2-8-4 type freight locomotives

Chicago & North Western purchases twelve which develop tractive force of 79,500 lb. with booster—Total weight 397,000 lb.

THE American Locomotive Company recently delivered 12 locomotives of the 2-8-4 type to the Chicago & North Western for use in freight service. These locomotives develop a tractive force of 67,200 lb. at 60 per cent cut-off. The rear pair of trailing truck wheels is equipped with a Franklin booster which furnishes an additional 12,300 lb. tractive force, working at 50 per cent cut-off. This gives a total starting tractive force of 79,500 lb. for the locomotive. The



Piping arrangement of the limited cut-off starting ports

boilers carry a pressure of 240 lb. and the cylinders are 28 in. in diameter by 30 in. stroke. The drivers are 63 in. in diameter. In working order these locomotives weigh 397,000 lb. of which 253,500 lb. is carried on the drivers, 39,000 lb. on the engine truck and 104,500 lb. on the trailing truck.

The boiler and steam control

The railway company's standards were maintained throughout as far as possible in the design of these locomotives, the Commonwealth Delta, four-wheel trailing trucks being used in connection with a Commonwealth cradle as on the previous order for 2-8-4 type locomotives, built for the railroad by the American Locomotive Company. The new locomotives are designed to negotiate maximum grades of one per cent, the curves on which are not compensated.

The boiler is of the radial stay, extended wagon top type, 86 in. inside diameter at the front and 94 in. outside diameter at the throat. Although it is intended to operate at 240 lb. working pressure, the boiler is capable of carrying a pressure of 250 lb. per sq. in. The barrel contains 204 3½-in. flues and 71 2-in. tubes, 20 ft. long. A Type E superheater having 102 units is used. The firebox is 150⅛ in. long and 96¼ in. wide inside the sheets, which gives a grate area of 100.3 sq. ft. It is fitted with two Nicholson thermic siphons and a brick arch, which is carried on two arch tubes and the siphons. Alco flexible staybolts are used in the throat, sides and back head.

Six of these locomotives are equipped with Duplex D-1 stokers while the remaining six are equipped with the Dupont Simplex type-B stoker. The engine for the Dupont stokers is located on the tender and the exhaust is piped into the tank. The exhaust from the Duplex stoker is carried into the cylinder saddles. Commonwealth cast steel ashpans of maximum capacity are used and are designed to provide an air opening equal to 180 per cent of the total tube area. The total evaporating surface of 4,872 sq. ft. is made up of 740 sq. ft. in the tubes, 3,721 sq. ft. in the flues, 288 sq. ft. in the firebox, 20 sq. ft. in the arch tubes and 103 sq. ft. in the siphons. The total superheating surface is 2,243 sq. ft., which gives a combined evaporative and superheating surface of 7,115 sq. ft.

An interior dry pipe conveys the steam from a shut-off valve in the dome to the superheater header, which contains a built-in American multiple type throttle. The steam distribution is controlled by a Walschaert valve gear arranged for 60 per cent maximum cut-off and is operated by means of a Barco reverse gear. A starting port arrangement is included in the limited cut-off feature, which is designed to eliminate excessive pre-admission.

The piping arrangement to the starting ports, on which a patent has been applied for, is shown in the drawing. An auxiliary port, formed in each valve chamber bushing, leads to the cylinder barrel through a pipe, the pipe tap into the cylinder being so located as to be covered by the piston, when at or near the end of the stroke to prevent undesirable pre-admission of steam. The blower, stoker and headlight generator are operated by superheated steam but the air compressors are operated by saturated steam. All 12 of these locomotives are equipped with Worthington locomotive feedwater pumps.

The running gear

The engine truck is the Commonwealth outside bearing type equipped with 33-in. diameter rolled steel wheels with 6½-in. by 12-in. journals. The wheels are interchangeable with the front wheels of the trailing truck. Markel removable type hub liners are applied to the engine truck and the front and back trailing truck journal boxes. The main driving boxes are of the Grisco type, the remaining driving journals being fitted with the Murrin three-piece bearing driving box. Six of these locomotives are equipped with Economy grease cellars and six with Franklin cellars. The main crank pins are hollow-bored for grease lubrication. The main rods are of the tandem type, forked at the main pin and extended to the rear crank pin. The frames are of Hylastic steel and have wearing plates riveted to each pedestal leg in accordance with the railway company's practice for use in connection with shoes and wedges formed without side flanges.

The tenders

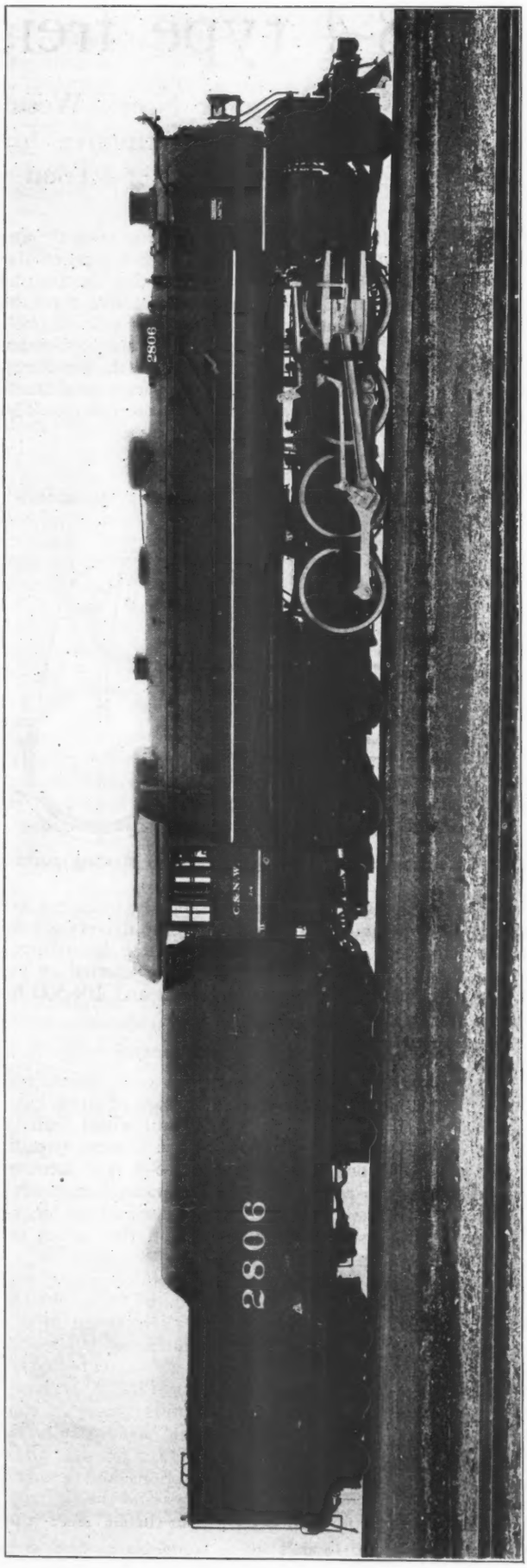
The tenders have a capacity of 15,000 gal. of water and 20 tons of coal. They have Commonwealth underframes and are carried on Commonwealth six-wheel trucks pro-

vided with clasp brakes. The wheels are of cast steel, 33 in. in diameter and have 6-in. by 11-in. journals.

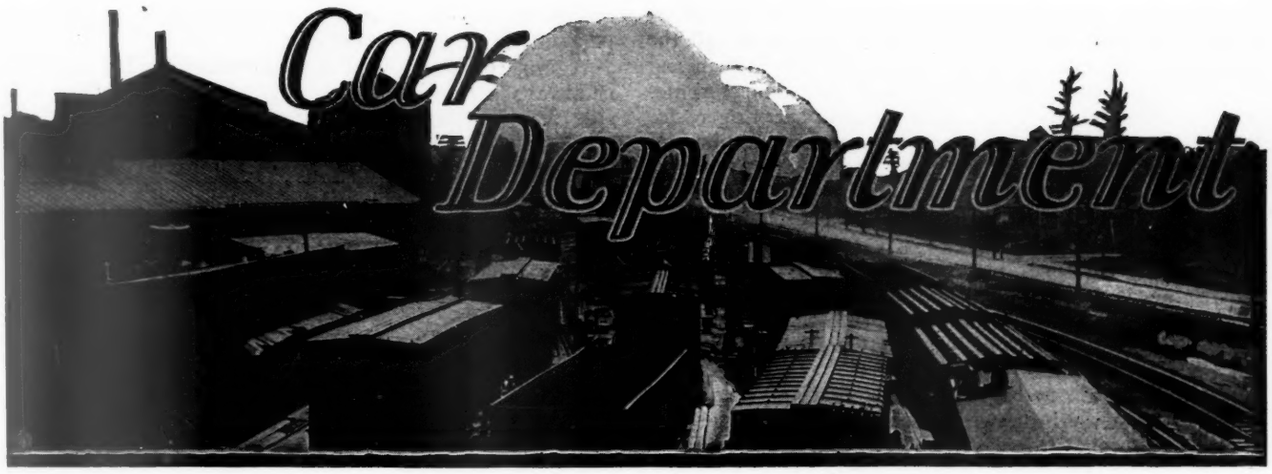
Table of dimensions, weights and proportions of the Chicago & North Western 2-8-4 type locomotive

Railroad	Chicago & North Western
Builder	American Locomotive Company
Type of locomotive	2-8-4
Service	Freight
Cylinders, diameter and stroke	28 in. by 30 in.
Valve gear, type	Walschaert
Valves, piston type, size	14 in.
Maximum travel	8½ in.
Outside lap	2 1/16 in.
Exhaust clearance	1/4 in.
Lead in full gear	3/16 in.
Cut-off in full gear, per cent	60
Weights in working order:	
On drivers	253,500 lb.
On front truck	39,000 lb.
On trailing truck	104,500 lb.
Total engine	397,000 lb.
Tender	287,000 lb.
Total engine and tender	684,000 lb.
Wheel bases:	
Driving	16 ft. 9 in.
Total engine	39 ft. 8 in.
Total engine and tender	82 ft. 3 in.
Wheels, diameter outside tires:	
Driving	63 in.
Front truck	33 in.
Trailing truck, front	33 in.
Trailing truck, rear	44 in.
Journals, diameter and length:	
Driving, main	12 in. by 14 in.
Driving, others	11 in. by 13 in.
Front truck	6½ in. by 12 in.
Trailing truck, front	6½ in. by 12 in.
Trailing truck, rear	9 in. by 14 in.
Boiler:	
Type	Straight top
Steam pressure	240 lb.
Fuel, kind	Bituminous
Diameter, first ring, inside	86 in.
Firebox, length and width	150 1/16 in. by 96¼ in.
Tubes, number and diameter	71—2 in.
Flues, number and diameter	204—3½ in.
Length over tube sheets	20 ft.
Grate area	100.3 sq. ft
Heating surfaces:	
Firebox	288 sq. ft.
Arch tubes and syphons	123 sq. ft.
Tubes and flues	4,461 sq. ft.
Total evaporative	4,872 sq. ft.
Superheating	2,243 sq. ft.
Comb. evaporative and superheating	7,115 sq. ft.
Tender:	
Water capacity	15,000 gal.
Fuel capacity	20 tons
Wheels, diameter outside tires	33 in.
Journals, diameter and length	6 in. by 11 in.
General data, estimated:	
Rated tractive force	67,200 lb.
Booster tractive force, 50 per cent cut-off	12,300 lb.
Total tractive force, engine and booster	79,500 lb.
Weight proportions:	
Weight on drivers ÷ total engine, per cent	63.8
Weight on drivers ÷ tractive force	3.77
Total weight engine ÷ comb. heat. surface	81.4
Boiler proportions:	
Tractive force ÷ comb. heating surface	9.45
Tractive force × dia. of drivers ÷ comb. heating surface	595
Firebox heat. surface ÷ grate area	2.87
Firebox heat. surface, per cent of evap. heat. surface	5.92
Superheat, surface, per cent of evap. heat. surface	46.2

CLASS I RAILROADS in August paid an average of $2.66 a ton for coal used as fuel for road locomotives in freight and passenger train service, as compared with $2.57 a ton paid in August, 1926, according to the Interstate Commerce Commission's monthly statement of railroad fuel statistics. The price ranged from $1.72 in the Pocahontas district to $4.44 in the New England district. For the eight months ended with August, the average price was $2.66, as compared with $2.61 in the corresponding months of last year. In the eight months the railroads expended $206,636,267 for coal and fuel oil, as compared with $209,946,169 in the corresponding period of 1926.



One of the twelve 2-8-4 type locomotives built for the Chicago & North Western by the American Locomotive Company



An analysis of truck side frame design

How to obtain a structure of maximum strength per pound of weight and also increased spring capacity

By Donald S. Barrows
Vice-president, The Symington Company, Rochester, N. Y.

THE complete history of the cast truck side frame would fill several volumes if only brief mention were made of each of the many attempts to escape from the limitations imposed by the three panel design. The following is necessarily a sketch written for the specific purpose of setting forth a few of the structural fundamentals which were not always observed by the earlier designers.

Not the least of the obstacles which beset the path of the designer of railway specialties is the natural desire

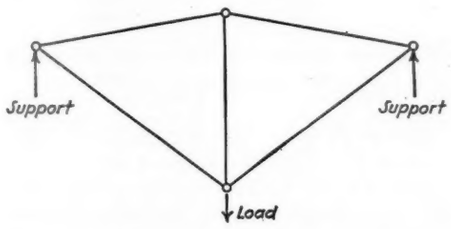


Fig. 1—A simple truss

of the railways that an improved device shall cost not more and preferably less than the device which it replaces. There is also the necessary requirement that more or less complete interchangeability shall be maintained between old and new devices. A very formidable obstacle was frequently the lack of agreement among railroad engineers as to the essentially desirable features and characteristics of a particular device, but the various mechanical committees of the American Railway Association are now probing more deeply each year to discover the fundamentals which underlie the successful design of car details, including in their work exhaustive tests of the materials of construction and of completed devices.

The freight truck side frame is theoretically a simple truss carrying the load at the center and supported at each end and if this were all, the determination of the fibre stresses in the component members of the truss and the proportioning of these members to give maximum strength with minimum weight would present a very simple problem, the diagram being somewhat like Fig. 1. The first practical difficulty arises from the fact that the bolster must be passed through the center of the truss, thereby dividing the center vertical member. This has the effect of adding a rectangular center panel to the truss outline so that the theoretical frame assumes the form shown in Fig. 2. If the external load from the bolster is thus divided and applied at the lower panel points, the stresses in the side frame truss would still be merely tension or compression and easily calculated. The load, however, is necessarily distributed over the center horizontal tension member so that this member be-

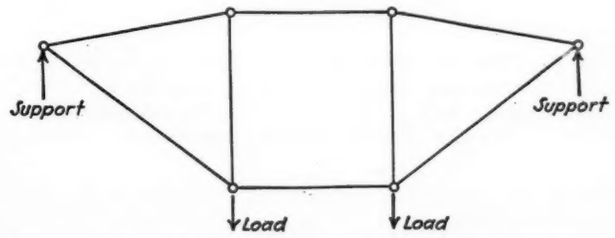


Fig. 2—The effect of adding a rectangular center panel to the simple truss outline

comes a beam subject to bending stresses as well as the tensile stress from its position in the truss. If this combination beam and tension member were pin connected at the base of the columns, it would deflect in a single curve somewhat like Fig. 3.

Freight truck side frame theoretically a simple truss

If; however, this member were rigidly held at its junction with the columns and inclined tension members, its

deflection curve would look like Fig. 4, but in the effort to hold this member as a beam with fixed ends, all the other members of the truss are subjected to bending stresses under the influence of which they deflect somewhat as shown in Fig. 5, so that the load carrying member is something between a simple beam and one having rigidly held ends. The actual total stresses at the various points require complicated calculations for their determinations. Furthermore, the actual combined stresses may, at certain points, vary widely from the calculated stresses through apparently minor foundry variations in the frame castings. This is the basic reason why a side frame calculation is only the start of the design and the final form must be proven by tests which will duplicate the varying conditions of service.

Referring again to Fig. 2, if the applied external load were divided exactly between the two halves of the side

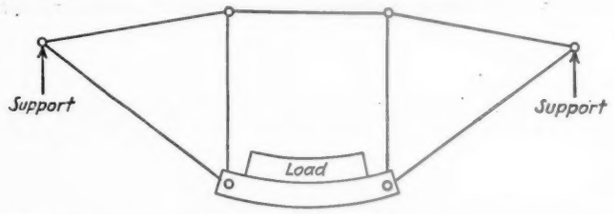


Fig. 3—If the combination beam and tension member were pin connected it would deflect in a single curve

frame truss, we could still assume in theory that the truss members were subject only to tension or compression, but the slightest inequality in loading between the two bottom panel points puts shear in the middle panel, and there is no diagonal member to resist it. Hence, we have a tendency of the rectangular center panel to distort. This tendency must be resisted by the intersecting members at the corners of the panel. We, therefore, have a theoretical distortion diagram somewhat like Fig. 6. Now, if we attempt to combine this last diagram and that shown in Fig. 5, we get a general idea of the various forces which act in unknown proportions on various truss members and, so far, we have only con-

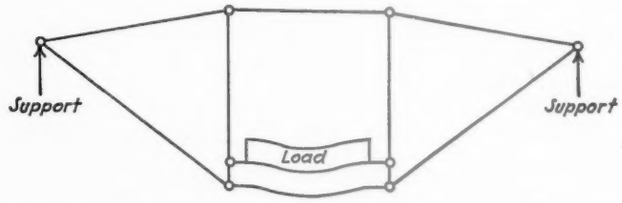


Fig. 4—What the deflection curve would look like if the combination beam and tension member were rigidly held at its junction with the columns and inclined tension members

sidered the effect of the bolster and springs on the original truss diagram.

No standard method of calculating side frame stresses

It is believed to be a correct statement that not only is there no established method of accurately calculating transverse and torsional stresses in side frames but no two independent designers seem to be able to agree as to the magnitude of the external loads producing these particular stresses or as to the correct point of their application. One consulting engineer states that while the A. R. A. specifications set a limiting stress from certain transverse forces, no one has ever proposed a method for calculating these transverse stresses that is within 500 per cent of being correct.

Again, the stability of a locomotive or of a tank car is always seriously considered, but the instability of a side frame under a certain combination of vertical and transverse forces is usually overlooked, with the result that no one seems to know whether journal bearing pressures per square inch are really uniformly maintained

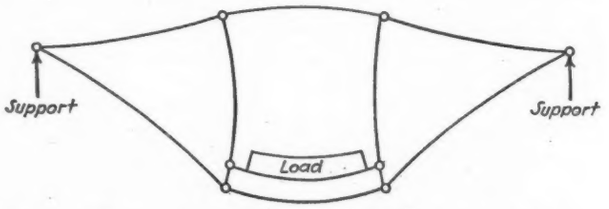


Fig. 5—The results obtained if the member is held as a beam with fixed ends

through the instrumentality of the standard wedge, or if we have occasionally five times the safe unit bearing pressure at one end of the journal, and a fraction of the normal pressure at the other. It is probable that the humble spring plank is more effective than the designer in preventing hot boxes. With this digression, we will return to our consideration of the design from the standpoint of vertical loading.

Difficulties encountered in the construction of the side frame truss ends

The construction at the ends of the side frame truss presents an entirely different set of difficulties to the designer who is anxious to avoid adding to the direct

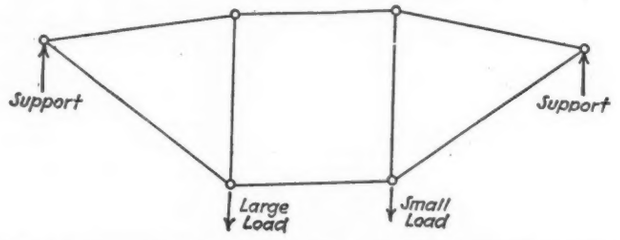


Fig. 6—Distortion caused by slight load inequality between two bottom panel points

stresses any more local bending stresses than is absolutely necessary, although some older forms of side frames were innocent of adequate provision for even the easily calculated stresses, thereby illustrating the psychological fact that the easiest way to surmount a difficulty, or to appear to have surmounted it, is to be unaware that the difficulty exists.

In the transition from arch bars to cast steel frames, the first popular commercial design of the latter was naturally proportioned to accommodate the standard arch bar type of journal box, the roof width for the latter preventing a correct intersection of the truss compression and tension members over the center of the journal. That portion of the frame which projected beyond this intersection became in effect a cantilever extension and for security should have been figured as such without reference to the uncertain influence of the bottom tie bar in resisting the upward deflection of the cantilevered portion of the frame through control of the rotative tendency of the journal box. The maximum local bending moment from the cantilevered end portion would occur at the intersection between compression and tension

members and resistance to this moment would be divided between these two members, the intensity of bending stress diminishing towards their respective intersections with the vertical truss member or column as represented by Fig. 7. Analyzed from this angle and without reference to the deformations from the bolster load, the deformation diagram might be represented by Fig. 8. If we combine this with Fig. 5 and 6, we have a composite

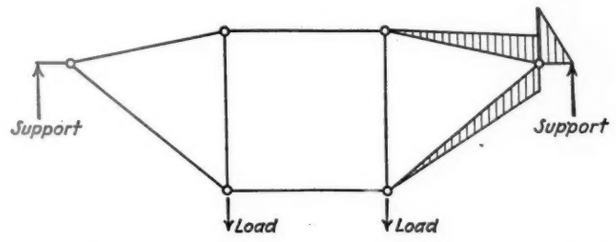


Fig. 7—The intensity of the bending stresses in the tension and compression members diminishes towards their respective intersections with the vertical truss member or column

of the deformations in the various truss members resulting from the unequal beam loading of the bottom member and from the cantilevered reactions, but we have still to add to the picture the straight line distortions from a simple truss action. These are shown in Fig. 9 which simply indicates the respective shortening and lengthening of the compression and tension members of the truss. Add this to the composite suggested immediately above and it will be observed how easy it is to be dogmatic about side frames and to prescribe simple standard calculations as a prerequisite to the acceptance of a new design.

The integral journal box presented opportunities for further analysis which were not immediately seized upon

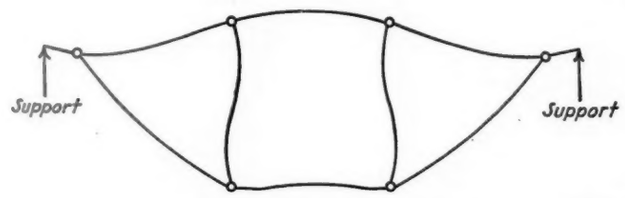


Fig. 8—The distortion from the cantilevered ends analyzed without reference to the deformation from the bolster load

by the earlier designers. It seemed possible to bring the intersection point of compression and the tension members exactly on the center of the axle. This was done by the simple process of discontinuing both members at their junction with the inner side wall of the journal box. The intersection, therefore, existed only on paper and the actual structure involved a large vertical non-intersection at the wall of the box, forced the box itself to act as a cantilevered beam and produced a very high local bending moment to be resisted by the combined compression and tension member through its least vertical dimension. Added to this was the matter of vertical shear, also resisted through this much stressed minimum section.

The progressive development of the integral type frame has resulted in the gradual elevation of the theoretical intersection point and an increase in depth of metal over the journal box until at present this depth is substantially equal to that of the Andrews or arch bar type frame.

Side frame tests

Long after the compression member was reluctantly raised above the roof of the integral box, the tension member was, and in some cases still is, anchored more or less securely to the relatively thin side wall of the journal box. The neutral axis of the compression member was waiting patiently for the intersection which would close the diagram, but that of the tension member was lost in the interior of the journal box. Frames of this type are frequently accepted on the basis of a stress diagram showing an intersection between the compression and tension members which does not exist in the casting. This raises the question as to the wisdom of incorporating in a side frame specification elementary requirements as to the calculation of the stresses in a simple truss, when the side frame itself, from the nature of its design, necessarily incorporates certain details of construction which affect the actual stresses to an extent which the diagram cannot indicate.

Faced with this difficulty of the accurate determination of the sufficiency of a side frame design through the re-

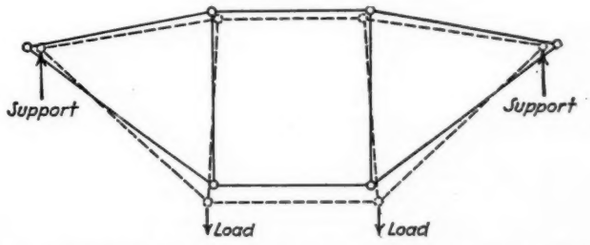


Fig. 9—Straight line distortions from the simple truss action

view of stress calculations, it would seem wiser if the railroads should instead specify methods of test which if passed by the specimen would seem to give assurance of a sufficient factor of safety.

The vertical static test seems logical because the frame is designed to carry a vertical load, but this test brings other difficulties in its train. The deflections from loads of from nine to twelve and one-half times the normal load so dislocate the truss diagram that the relationship which exists between the normal working stresses is not maintained, with the result that the average frame fails under static test in a manner in which it never has and cannot possibly fail in service, namely, by buckling of

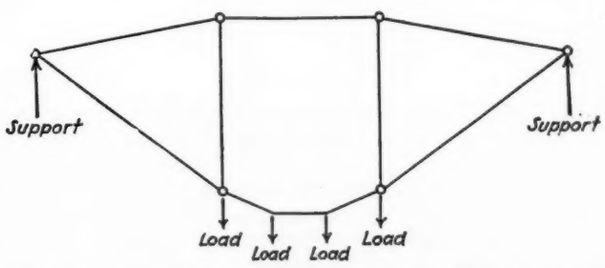


Fig. 10—A suspension line for four symmetrically arranged loads

the entire compression member. In order to pass a high static test with a very small deflection and set which are sometimes specified, it becomes necessary to design the frame for the test rather than for service and undoubtedly an appreciation of this fact led the American Steel Foundries and the Symington Company to design and build fatigue test machines in an effort to apply to a test specimen the same various forms of treatment which it receives in service and by the rapid repetition or alter-

nation of service shocks to condense the experience of several years into a few days. The appropriate A. R. A. committee has taken cognizance of the important matter of side frame test and, in due course, there will probably issue specifications properly safeguarding the railroads without burdening unduly the manufacturers.

The problem of additional spring capacity

As the development of the side frame as a correctly proportioned truss seems to approach a satisfactory conclusion, the question of additional spring capacity arises to revive interest in the whole matter. It seems to be the case that the present standard springs do not provide reserve capacity to balance the rest of the truck structure. The correct solution may require springs of the existing external dimensions but of higher grade ma-

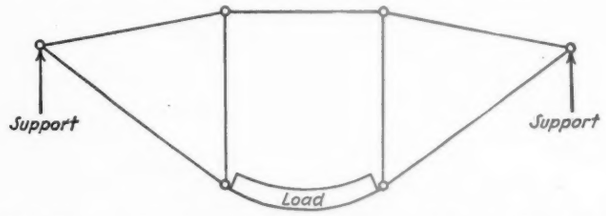


Fig. 11—A curved suspension line formed by a distributed load

terial and greater capacity, or it may be deemed wise to hold to the present spring characteristics and use more coils per truck. From the standpoint of maintenance, there is much to be said for the latter alternative. The present standard A. R. A. coils are nearly as familiar and as available as postage stamps and a change in spring standards would bring complications not unmixed with danger. If higher grade springs were of the old external dimensions, incorrect replacements would be inevitable and where individual coils were replaced, unbalanced loading would result.

For many years some designers have tried honestly to utilize the theoretical economy of the catenary principle, and several built up arch bar trucks incorporate this feature to a limited extent. The Dalman truck is

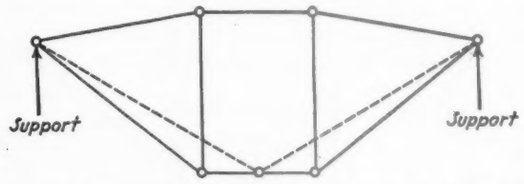


Fig. 12—A diagrammatic illustration of the double truss side frame

the most recent commercial exposition of the catenary theory. The latter requires, in case of several separated concentrated loads, the application of these loads at points on a theoretical suspension line of the shape which a flexible tension member would assume if it were anchored over each journal box. With four symmetrically arranged loads, the diagram would be somewhat like Fig. 10, and if the load should be considered as distributed rather than concentrated, then the suspension line would form a curve like Fig. 11.

The economy of the catenary construction lies in the fact that at each point, the inclination of the tension member coincides with the resultant of the forces acting at that section and it therefore follows that if this contour is produced in a relatively rigid and unyielding structure, the load application must actually coincide with the original assumption. Otherwise there will be a departure from the theoretical diagram producing secondary stresses which the structure must meet. This part of the problem is similar to that which confronts the designer of any other type of frame. The loading cannot be exactly uniform and secondary stresses are necessarily set up at all the rigid joints of the integral structure.

The only other recent serious departure from the traditional form of simple truss is illustrated by the latest Symington frame in which the disposition of the springs permits a truss structure having an integral but auxiliary tension member running directly from the top of each journal box to an approximate intersection at the center of and u[illegible]neath the spring group. This is intended to reduce the deflection or deformation of the spring-carrying portion by dividing the total span into two half length segments, and has somewhat the same effect upon the stresses in and the deflection of the beam portion of the main tension member as would result from building a middle pier under an existing bridge truss. The frame so constructed is designated as the "double truss" side frame in recognition of the principle which

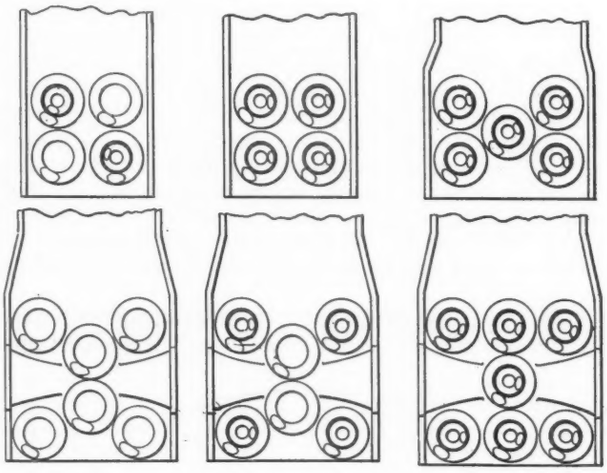


Fig. 13—A comparison between the present A. R. A. and the new spring groups for three standard capacity cars—Left, 40-ton cars; center, 50-ton cars; right, 70-ton cars

guided its design and which is illustrated diagrammatically in Fig. 12.

The H-shaped spring group, besides permitting a stiffer structural design of frame, provides a bolster support approximately three springs square. Observation of many worn side frames and bolsters seems to show the need for a better means of controlling longitudinal and transverse angular movement of the bolster with respect to the side frame. This control cannot be rigid for a definite restriction of relative angular movement would be disastrous, but a cushioned control of such movement tends to avoid shock and decrease wear. In Fig. 13 there is shown a straight comparison between the present A. R. A. and the new Symington spring groups for the three standard capacity cars.

Limitation of the above discussion to only two recent comercial frames is perhaps, permissible because they are the only two departures from the conventional design which were made for the specific purpose of securing not only increased spring capacity, but a structure of maximum strength per pound of weight. While they represent somewhat divergent methods of accomplishing the desired result, the discussion which may be inspired

by this very contrast will at least serve the purpose of preventing any serious future consideration of a side frame in which the designer has merely built a rectangular loop around the bolster opening and connected this loop to two journal boxes by four members proportioned by eye and intersecting at the point most convenient for the foundry.

Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Extent of damage to car did not warrant a statement to the owner

Atlanta, Birmingham & Atlantic box car No. 24039, all wood, 60,000 lb. capacity was reported, on April 18, 1923, by the Pennsylvania as being held for disposition under A.R.A. Rule 120. The joint inspection certificate submitted showed that the estimated cost of repairs, labor and material amounted to $540. The Pennsylvania contended that there was no Rule 32 condition involved and that there was no damage nor condition on the car to indicate a derailment or other unfair usage, but that the defects were cumulative and due to ordinary service; also, that since the damage did not come within the provisions of the footnote of Rule 43, there was no requirement that a statement should be furnished showing how the defects developed. The owner sent a representative to inspect the records to ascertain the cause of the damage, but found no records available. The owner, therefore, complained that records should be available in view of the Supplementary Regulations (Section IV-A) as to the preparation of accident reports for each car damaged. The question involved in this case was whether or not the footnote of Rule 43 or the Supplementary Regulations takes precedence.

The decision was to the effect that the extent of the damage to the car did not warrant a statement being furnished to the owner under Rule 43. The owner was held responsible.—*Case No.* 1484, *Atlanta, Birmingham and Atlantic vs. Pennsylvania.*

Air brakes cleaned by a terminal company for different roads within 60 days

On February 15, 1925, the Portland Terminal Company cleaned the air brakes on ERDX car No. 152437 for which a charge was rendered against the Merchants Despatch, Inc. In the Terminal Company's bill, the repair card was stamped "Repaired for Maine Central." On April 12, 1925, the Portland Terminal again cleaned the air brakes on this car, at the same point of repairs, for which the charge was rendered against the Merchants Despatch in the same bill. In this instance, the repair card was stamped, "Repaired for the Boston & Maine." The Merchants Despatch took exception to this second charge for air brake cleaning claiming that Interpretation No. 3 to Rule 60 covers this case fully owing to the fact that both cleanings were performed on the same road at the same point within the 60-day limit as prescribed in the above interpretation. The Portland Terminal Company contended that Interpretation 3 to Rule 60 did not cover this case owing to the fact that the repairs were made for two different roads.

The Arbitration Committee stated that "the contention of the owner is not sustained, inasmuch as the air brakes were cleaned by the Portland Terminal Company for two different roads. Interpretation No. 3 of Rule 60 does not apply."—*Case No.* 1485, *Merchants Despatch, Inc. vs. Portland Terminal Company.*

Joint statement not conclusive evidence that repairs were made

The North American Car Company rendered a repair bill to the Chicago & Alton amounting to $231.90, covering repairs to ESPX car No. 262 which included the renewal of one 36-ft. side sill and repairs to four body truss rods. On April 4, 1925, a joint inspection was made of the car which showed that the side sill had been spliced with one piece of 6-in. by 9-in. by 10-in. lumber and that the four truss rods had not been straightened. This information was sent to the North American Car Company which acknowledged its error in charging for a full length sill and reduced the bill to $170.20, but refused to acknowledge that the truss rod charge was in error.

The decision of the committee was to the effect that the North American Car Company made a positive statement that the truss rods were repaired. Their bill, therefore, was sustained.—*Case No.* 1486, *Chicago & Alton vs. North American Car Company.*

Establishing a claim that a car was equipped with a dirt collector

On June 29, 1924, the Boston & Maine cleaned the air brake equipment as per Rule 60 on Main Central car No. 30349 on account of the car being stenciled MC 7-17-23. The billing repair card did not show that the dirt collector had been cleaned or drained or that the car had been equipped with a dirt collector. The last previous record showed that this car had had the brakes cleaned by the Delaware & Hudson on July 17, 1923, on account of an old date. The billing repair card rendered at that time showed that the car had a dirt collector. The next subsequent record showed that the car had the brakes cleaned by the Portland Terminal Company on June 27, 1925, on account of an old date. The billing repair card rendered at this time also showed that the dirt collector had been cleaned and drained. On August 10, 1925, the Maine Central presented to the Boston & Maine, under Rule 90, a joint evidence certificate to the effect that it had failed to clean and properly report the dirt collector and therefore, requested their counterbilling authority for $4.35, covering the cleaning, oiling, repairing and testing of brake equipment. The Boston & Maine contended that no exception had been taken to this charge until August 10, 1925 or twelve months after the bill had been rendered, which is a violation to the time allowed by Rule 91. Furthermore, the Maine Central failed to produce conclusive evidence that the car had been equipped with a dirt collector.

The Arbitration Committee rendered the following decision: "The repair card of the Boston & Maine states specifically that the car was not equipped with a dirt collector. The car owner had furnished no conclusive evidence to show that the car was so equipped at the

time the brakes were cleaned. The bill of the Boston & Maine is sustaind."—*Case No.* 1488, *Maine Central vs. Boston & Maine.*

Responsibility for car reported under Rule 120 and subsequently destroyed

Chicago, Rock Island & Pacific (Mather) car No. 500501 was reported to the owner as destroyed on the Atchison, Topeka & Santa Fe lines on September 22, 1924. On October 22, 1924, the A.T.&S.F. furnished the Mather Stock Car Company a joint inspection in which a statement was made to the effect that the accident occurred when the car was in a train being hauled by two locomotives. The trucks, coupler and underframing on the A-end of the car was pulled out enroute. There was no rough handling, the failure having occurred in ordinary usage. The owner took exceptions to the reporting of the car under Rule 120 and on October 27, 1924, furnished a depreciated value of the car. On December 2, 1924, the owner requested copies of the accident reports which were furnished by the handling line. On January 5, 1925, a representative of the owner called on the A.T. & S.F. to discuss the case and at that time was informed that within the next few days after the damaged car had been unloaded from a flat car, that Indians from a nearby reservation carried away nearly of the car but the trucks and for this reason there was no necessity for an inspection. The A.T. & S.F. contended that the owner was responsible and should have rendered a bill to cover salvage only, as per Rule 120. The owner contended that the trucks having been pulled out from under the car that the handling line was responsible and further contended that the Santa Fe was responsible for the failure to preserve the car for inspection while in its possession.

The Arbitration Committee stated that "the handling line was responsible."—*Case No.* 1487, *Mather Stock Car Company vs. Atchison, Topeka & Santa Fe.*

Total store expense on material ordered from owner and shipped direct from manufacturer

On November 24, 1924, Chicago, Rock Island & Pacific car No. 262384 was damaged by fire on the Southern Pacific, after which a request was made on the owner for a description and depreciated value of the car. Upon receipt of this information the Southern Pacific decided to repair the car. On January 7, 1925, the owner placed an order on the C. R. I. & P. for one Hutchins all-steel flexible roof. This material was shipped direct from the manufacturer to the Southern Pacific on February 28, 1925. On March 16, 1925, the Southern Pacific received from the owner a bill for $205.28, covering one roof at $178.50, plus 15 per cent for handling and accounting, or $26.78. The item of 15 per cent on a direct factory shipment was objected to and the bill was returned to the owner for elimination of this item. At first the owner maintained that the bill was correct as rendered, but later agreed to reduce the bill in the amount of $10.63, or the equivalent of the freight charges for shipping the roof. The Southern Pacific declined to consider this amount and produced a copy of a freight bill for $48.25 to show that it had paid the entire freight haul on this shipment from the manufacturer's plant to California where the car was repaired. The Southern Pacific claimed that it should not be called on to accept any additional charge over and above the cost of the roof. The stand taken by the owner was predicated on A.R.A. Rule 105 and Interpretation No. 1 of that rule.

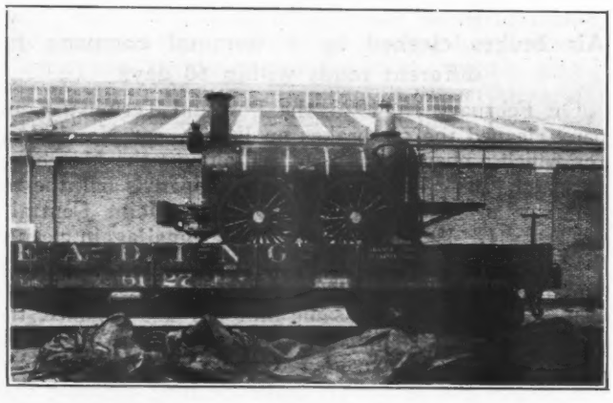
The Arbitration Committee stated that, "The bill of the Chicago, Rock Island & Pacific for material in question should be confined to the factory price, omitting stores expense."—*Case No. 1489—Chicago, Rock Island & Pacific vs. Southern Pacific.*

A safety-first kink for pipe bending

THERE is always some possibility of a workman being injured when bending a long piece of pipe with a pipe bender of the type shown in the illustration. This possibility can be practically eliminated by locating the operating valve some distance away from the dies in which the pipe is bent. The operating valve on the

The operating valve is located eight feet from the machine to avoid possible injury to the workman

pipe bender shown is a locomotive straight-air brake valve bolted to the end of a channel about 8 ft. away from the bending dies. Practically all of the material used in the construction of this pipe bender is from scrap parts of freight cars. The column on which the bender is mounted also supports a pyramid-shaped roof. This bender is located in the car yard and is used for bending train line pipe to be installed on freight cars.



The Reading's "Rocket"—1838—Exhibited at the Fair of the Iron Horse, Halethorpe, Md.

Central Railroad of New Jersey car repair tracks at the Penobscot classification yards

Modern car repair tracks

Central of New Jersey improves the facilities at its Penobscot classification yard

THE Central Railroad of New Jersey recently completed a number of improvements in the car repair tracks at its Penobscot, Pa., classification yard, which is located about 17 miles east of Wilkes-Barre. The yard is located at the top of the Ashley planes, over which a large number of cars of coal are received in addition to the regular east bound freight going through that point.

The story of the Ashley planes, which forms an important link in the operation of the classification yard, is replete with historic interest. These planes were built and placed in operation by the Lehigh Coal & Navigation Company in 1843. From Ashley, Pa., where connection is made with the Lehigh Valley, they extend eastward to the top of the mountain at Penobscot. The operating company also owned a three-mile railroad that ran from the foot of the planes to the North Branch canal at Wilkes-Barre. This line was used to transfer canal boats loaded with freight and coal from one canal to the other.

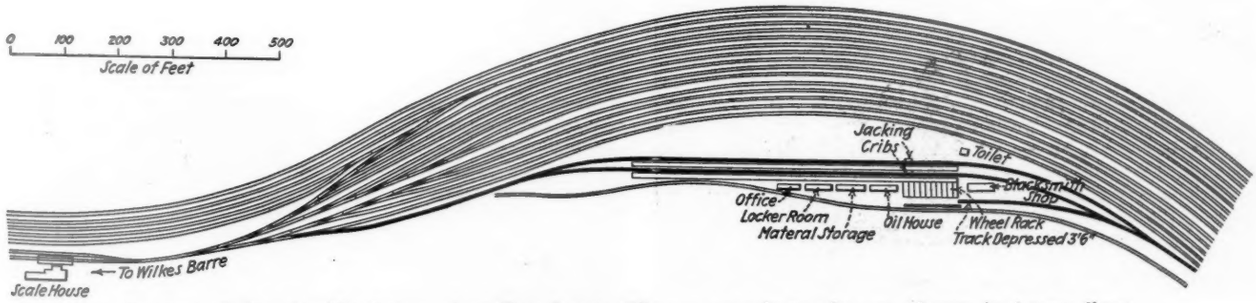
The three planes, which constitute the plane system, are 12.3 miles in length and are now used by the Central Railroad of New Jersey for the transportation of coal up the mountain from the Wyoming valley to the Penobscot yard. The total straight line distance up the mountain, however, from the point where the planes begin to the point where they end, is slightly less than three miles.

Both passenger and freight traffic was carried over the planes until 1867, when the present main line was built around the mountain and extended from Easton, Pa., to White Haven. Since 1867, the planes have been used for hoisting coal and freight, empty cars being routed via the main line around the mountain.

Ashley planes a unique feature in railroad operation

Although the operation and construction of the Ashley planes are not directly related to the operation and description of the car repair tracks at Penobscot, a brief account of the plane system will not be without interest. Hoisting engines are located at the top of each plane. All three planes are double-tracked and cars are hauled up each plane by means of a cable attached to a four-wheel truck. The flanges on the wheels of this truck engage the outside of the rail instead of the inside. Each wheel turns on an independent axle which revolves in a sleeve. This sleeve moves parallel to its axis so that the distance between the wheels can be either lengthened or shortened to suit three different gages of track. Latches for releasing the sleeves are provided which are automatically disengaged as the wheels arrive at a change of gage in the track.

Loaded cars are placed over a pit between the rails of the standard gage track at the foot of each plane. The cable truck moves down the incline by gravity and as it nears the foot of the incline, the wheels automatically adjust themselves to a track of narrower gage than the



Layout of the classification yard at Penobscot—The car repair tracks are shown in heavy lines

standard, the rails being laid inside the rails for the standard gage track. Finally, the cable truck adjusts itself to a track of still narrower gage which runs down a steep incline and along the bottom of the pit and under the train of cars. It continues on this track until it comes out at the opposite end of the pit and once more adjusts itself to the standard gage. The cable truck engages the coupler on the rear car so that the cars are pushed instead of pulled up the plane.

Cars go via the planes direct to Penobscot yard

Loaded cars from the third or top plane are switched direct to the Penobscot classification yards. The layout of the tracks is shown in the drawing. All cars are inspected enroute to the scales. Cars in need of repairs

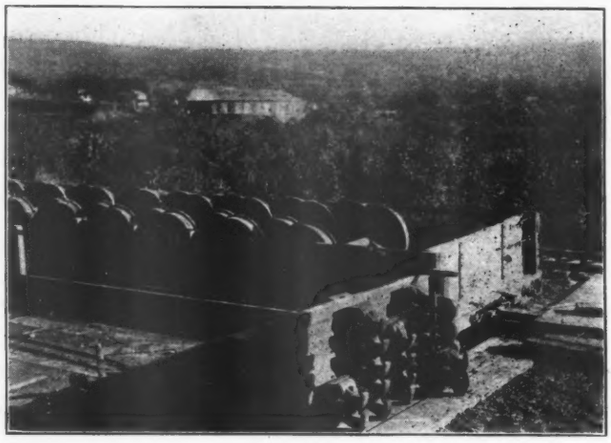
Looking down No. 3 plane

are run down the hump to one of the two car repair tracks. All cars in need of repairs and loaded with rush shipments, are routed to one repair track where repairs are promptly made and the cars returned to service.

The short time in which cars containing rush shipments can be repaired and returned to service is one of the features in the operation of the repair tracks. This is accomplished by the following procedure: Cars going slow freight and requiring repairs that consume some time are dropped on to one repair track. Ordinarily there is a sufficient number of these cars to keep all the car repair men busy. However, a car containing a rush shipment or going fast freight is dropped down to the other repair track where repairs are made at once and the car is then released for service. Cars going slow freight that require only very light repairs can also be routed over the same track with the cars containing rush shipments without incurring any delay.

Excellent facilities are provided

The layout of the repair tracks with respect to the classification yard proper is of considerable assistance in expediting the work. Both of the repair tracks are pro-



Wheels are unloaded from the end of a car onto wheel storage tracks located at the same height as the floor of the car

vided with toad derails located at the upper end of the working area. Blue flags are placed at each derail while cars are being worked on. Sufficient trackage is provided between the derails and the scales to hold the cars requiring repairs that come over the hump.

The area between the two tracks and on both sides is graded level to the top of the ties and a platform of

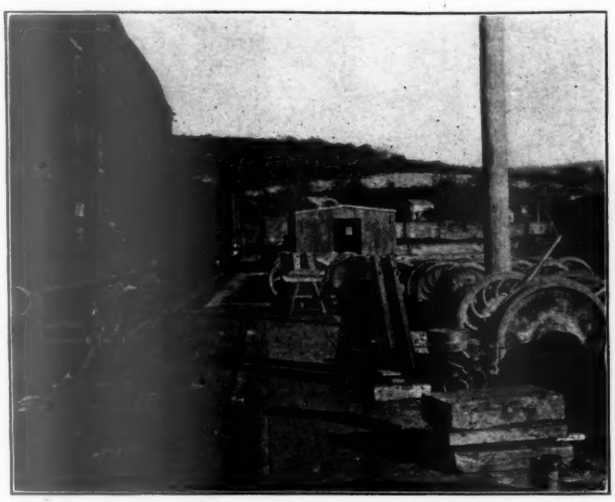
Another view of the material storage bins

3-in. by 12-in. planks is built between the tracks and in front of the buildings, as shown in the drawing and also in some of the photographs. The platform in front of the wheel storage area is built solid to the outside rail of the second repair track to facilitate the handling of wheels to and from the cars.

All wheel renewals are made on this spot, permanent

foundations for the car jacks being provided. The jack rests on a sheet of ¾-in. boiler plate which in turn rests on a concrete base. The whole is supported on cribbing built of 12-in. by 12-in. cross ties buried in the ground. This cribbing was built up about 6 ft. high from the bottom of the pit before being filled in.

The arrangement and location of the buildings has



Looking down track No. 1

also been planned with the express purpose of expediting the work. All the buildings are constructed from old wooden box car bodies with the exception of the blacksmith shop, which is 14 ft. wide by 48 ft. long. Wheel renewal being the heaviest work performed, the wheel storage is located directly opposite the jacking

Looking up between the two repair tracks

cribs. The oil house and material storage building are located on one side of the wheel storage area and the blacksmith shop on the opposite side. Additional bins and racks are provided below the blacksmith shop for the storage of couplers and heavy castings. Racks and bins are also provided between the material storage building and the oil house for small parts. The building between the office and the material storage building is provided with lockers for the men.

Cars with material shipped from stores to Penobscot are switched to the depressed track in rear of the blacksmith shop. This track is depressed so that the floor of the car is level with the storage platforms which also facilitates the unloading of wheels from the car. The type of car used for shipping wheels to outlying repair points is shown in two of the illustrations. These cars are reinforced gondolas of wood construction fitted with removable ends. To unload, the end gates are removed and the wheels are rolled out the end of the car over a gang plank to storage.

Seven repairmen, under the supervision of a foreman, are employed at Penobscot in car repair work. These men make light repairs to over 400 cars per month. No repair work, aside from what is actually performed on the cars, is handled at this point. All material and air brake parts, such as triple valves, etc., are received at this point ready for application. Material removed is shipped to the Ashley car shops to be reclaimed. The blacksmith shop contains only one hand forge and is used primarily in connection with repairs to safety appliances and brake rigging. The repair yard is piped with compressed air for pneumatic tools. The same compressor which provides air for testing the brakes on trains in the classification yard, serves the car repair tracks.

The grade from the derail to the repair platform is 14 in. in 300 ft. From there it has a slightly steeper grade to the point where the two repair tracks come together. As soon as a car is repaired and stencilled, it is dropped to the end of the repair tracks where it is picked up by the yard engine and switched to an outbound train.

Inspection and reports are important part of the work

All cars are inspected by the foreman as they arrive at the repair track. Considerable importance, however, is given to the inspection of cars leaving the repair track. This is especially true with respect to air brakes, journal boxes, wheels and draft gears. All work reports must check with the work actually performed and it is the policy of the management to maintain careful supervision over this phase of the work at all times. Cars in need of heavy repairs are tagged with "bad order" cards and sent to Ashley for repairs.

Rock Island reclaims car roofs

CAREFUL attention is given to metal freight car roofs on the Chicago, Rock Island & Pacific. Roofs taken off for the purpose of making repairs to car structures or for relaying roof linings, are removed with care and reused on the same cars. Metal roofs with small defects are repaired on the cars. Roofs that are extensively defective, with sheets split in the folds or rusted through in spots, are gathered up and sent to the One hundred twenty-fourth street (Chicago) shops for sorting and reworking. Such roofs were formerly reclaimed at numerous shop points, but this work on the entire system is now all handled at the one shop. The method of loading a gondola with roof sheets for shipment is plainly indicated in the illustrations as are also the methods of sorting and handling the sheets.

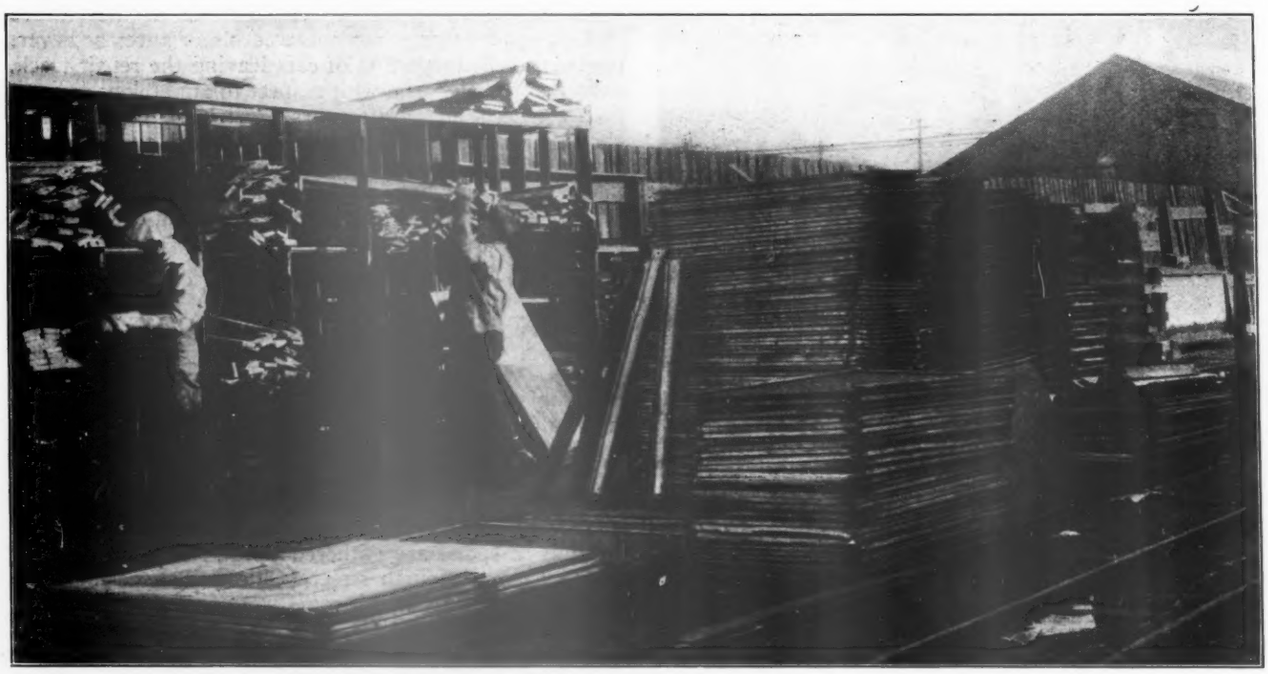
In order to take care of the large quantity of removed sheets forwarded to One hundred twenty-fourth street shops, it has been necessary to assign one man to inspect these sheets who understands thoroughly the requirements for car roofing as well as the various styles

used on different equipment. The shipments as received are unloaded and carefully gone over by the inspector who sorts them into five general classes: first, sheets (often practically new) which can be matched up and again applied to a roof without having any work done on them; second, sheets in sufficiently good condition to be sheared and manufactured into smaller roof sheets; third, sheets too small to be manufactured into roof sheets but which can be sheared into 24-in. by 48-in. sheets for building and other purposes; fourth, deteriorated sheets from which one or more 12-in. by 12-in. good sections can be cut; fifth, sheets good only for scrap.

Sheets in the first classification, which may be matched up and applied to other cars without reconditioning work, are called "reclaimed." Those in the second classification, on which certain machine operations, including shearing and forming, must be performed, are called "rebuilt." Sheets handled under the third and fourth classifications are used for manufacturing various articles required by the railroad such as roofing material, sheathing, stove pipes and elbows, smoke jacks, etc.

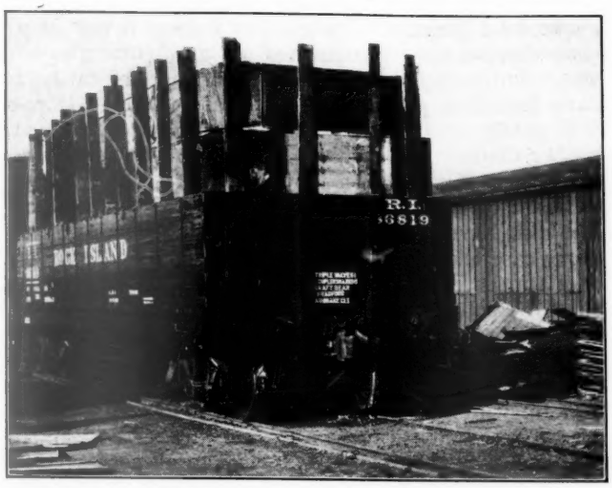
Ample space is necessary for the efficient sorting and handling of roof sheets

Some idea of the volume of work handled may be gained from the fact that in a year (1926) a total of 1,052 car roofs were applied at the One-hundred-and-twenty-fourth street shops, of which 322, or almost 27 a month, were reclaimed and 256, or 22 a month, were rebuilt; the balance of the roofs were new since not enough reclaimed and rebuilt roofs were available to meet the demand. The labor cost of handling the 578 reclaimed and rebuilt roofs averaged $3.65 each, as against an approximate cost of $47.50 for a new roof,



Reclaimed roof sheets piled in the foreground—Roof caps in the racks

so the work of reclamation is highly profitable in spite of the shorter life of reclaimed roofs as compared with that of new ones. In the same period of 12 months,



Close-up view showing the method of loading a gondola car

the roof sheets with insufficient good material to be formed into rebuilt roofs were cut up and manufactured into the following articles used by the railroad: 59,607 sheets 20 in. by 24 in. for building purposes; 6,730 stove pipes and elbows; 700 smoke jacks; 3,600 sheets 12 in. by 12 in. square for various other purposes.

The actual work of the inspector in reclaiming car roofs consists in picking out the individual sheets still good for further service, sorting them and placing each type or style in a pile by itself. In due time enough sheets of each style are accumulated to form a complete car roof, and material men then deliver the sheets to whatever car may be designated by the foreman. In the case of sheets handled under the second classification, when enough are accumulated in one pile, they are delivered to the tin shop for manufacturing of the rebuilt roof. They are first sheared to the proper size on large squaring shears and then, by the use of various processes and dies, the edges of the roof sheets are properly formed. In manufacturing these roofs it is also necessary to manufacture the caps which go over the joints of the sheets, and this is done in two operations, the first on the brake, and the second on the press, using dies of the proper design.

All rebuilt roofs are manufactured on a shop order issued by the stores department and these roofs are turned over to the stores department to be delivered to the local shop or to any other point on the railroad, should there be a surplus. The reclaimed roofs are held at the shop and sent directly into the yard for application without going through the stores department.

Car men discuss interchange rules

Railway Car Department Officers Association gives consideration to changes in rules

AT the annual convention of the Railway Car Department Officers Association held at Chicago August 23-25 inclusive, the usual consideration was given to changes in the American Railway Association code of rules for the interchange of traffic. A partial report of the convention proceedings has been published in previous issues of the *Railway Mechanical Engineer*, the discussion of billing repair cards and the report of the Question Box committee appearing on pages 723 to 727 inclusive of the November issue. The present issue contains the discussion of changes in the interchange rules, Supplement No. 1, and effective August 1, 1927. The general method was for one of the members to read a rule and then time was taken to discuss any points in question. The following should be read in conjunction with Supplement No. 1, issued by the American Railway Association.

Discussion of Supplement

Rule 1

A. R. SCHROEDER (M. C.): I don't understand why the rule was changed. Nobody wants to make extensive repairs to foreign cars and it appears as though they want us to cut down on the repairs and make necessary repairs only.

V. R. HAWTHORNE (A.R.A.): This is one of the most important changes the Arbitration Committee has made to protect car owners having cars of certain age and series that are being retired from service. On account of these cars as a general rule being easy to repair, too many were being repaired to the extent of practically re-building them. The car owner should have the privilege of setting his own standard of maintenance and it is certainly very undesirable to have extensive repairs made to cars in line for retirement. Such cars should by all means be sent home for repairs, if at all practicable, especially so if there is a direct connection with the car owner. If that cannot be done, they should be reported under Rule 120. If the proper effort is made, such cars can be moved homeward under load.

J. H. EDDY (C. R. R. of N. J.): Would that apply to any other cars? There are a number of cars used that are not stenciled.

E. S. SWIFT (Wabash): I would say that Section 3 of this rule applies only to tank and poultry cars.

Rule 17

W. M. ALLISON (D. T. & I.): I have not had my mind made clear as to how we can repair cars of foreign ownership with a 6-in. by 8-in. shank and 9⅛-in. butt coupler. I take it that if we get one of those cars on the repair track, I will have to give my defect card if it is not replaced in kind. I do not consider it right that when we make repairs to a foreign car, we have to give back our labor expended on that car. I would like an explanation of this.

M. E. FITZGERALD (C. & E. I.): If you have not one of the same kind in stock you can apply a Type D coupler.

MR. ALLISON: You have to change the entire yoke to apply a Type D coupler. I had a case like this on

our own repair tracks on a loaded car. To make correct repairs I had to transfer the load and hold the car until we could get a coupler from the owner. What we did was to put in a 5-in. by 7-in. by 9⅛-in. butt Type D coupler. We did this in order to make a test case.

MR. HAWTHORNE: It is my personal opinion that a Type D A.R.A. standard coupler would be used in order to avoid wrong repairs. If another type of coupler is applied which is not standard to the car it is wrong repairs.

Rule 30

T. J. O'DONNELL (C. I. I., Buffalo, N. Y.): May I ask in connection with this whether or not joint evidence is due when the new light weight stencil is omitted or improperly applied?

E. S. SWIFT (Wabash): It says the complete marking.

W. J. OWEN (P. & P. U.): I think if the car is properly stencilled showing the car weight and date that it is sufficient, even though one or two of the figures are better than the others.

F. A. STARR (C. & O.): I have always been informed that the rules were made primarily for the protection of the car owners. Why pass up responsibility for having the right weight stenciled?

F. E. LLOYD (C. N.): If we had to re-weigh a car and we fail to stencil the light weight properly you should have joint evidence.

MR. FITZGERALD: The old stencil marks should be entirely painted out, and the new properly applied and I am quite satisfied that joint evidence or defect card is due if that is not done. The defect card should read for the labor only of painting the new stencil on the car and not for the re-weighing of the car. All that the joint evidence should cover should be the improper stenciling.

MR. LLOYD: What labor charge would you make?

J. J. WHELAN (B. & O.): One-half labor charge.

MR. SCHROEDER: Why not go right along with the rule if the thing isn't done in accordance with the A.R.A.?

MR. FITZGERALD: I would like for this motion to provide that joint evidence and the charge would be confined to 107-419 B.

PRESIDENT B. F. JAMISON (Southern): This association should go on record of not abusing the other man's property.

C. F. NELSON (C. I. I., Chicago): I move that it is the sense of this body that in cases where new light weight is not properly applied or the old stenciling is improperly obliterated, joint evidence is in order.

(*The discussion closed without taking a vote, there being no second to Mr. Nelson's motion.*)

Rule 36

MR. O'DONNELL: I think we recommended last year that the dome caution card on tanks of tank cars be allowed to remain on the dome permanently. It is dangerous for our men to get up there to take them off. We are still charging the delivery lines for the removal of those cards.

MR. NELSON: I understand that the Bureau of Explosives has already taken action on this, and that it will be taken care of by the Arbitration Committee as soon as the Bureau of Explosives has decided just what should be done.

We car men, in my opinion, are not co-operating with the American Railway Association as we should in attempting to eliminate the use of non-standard placards. Thousands of such cards are being used throughout this country, and it seems as though the shippers are making a studied effort to inject as much advertising material on the cards as possible. It is my impression that we are handling the matter along the lines of least resistance. It is not my desire to boast about what Chicago is doing, but I deem it my duty to state that we have inaugurated a vigorous campaign toward eliminating the use of the non-standard cards, and have found in practically every case that the shippers will gladly co-operate with us if approached in the proper manner. We have succeeded in having some of our largest shippers, who formerly used nothing but non-standard cards, adopt the use of standard cards entirely. We also have a plan in effect which provides that in every case where a defect card is issued for the removal of placards from cars, one of the placards must accompany the copy of defect card to the delivering line. It would surprise you to know the large number of placards that were being removed that should not have been removed, also the remedial effect of having delivering lines take up with shippers the question of discontinuing the use of non-standard cards and substituting the standard. I believe that it would be beneficial to all concerned for all of us to unite in coping with this situation, assuming of course, that the rule was written for the purpose of getting results.

J. E. MEHAN (C. M. & St. P.): We are having a lot of trouble with commodity cards. I have in mind a card on which the words, "Badger State Cement" are printed on the upper two-fifths. It is my judgment that in accordance with the cut on page 260, there is nothing to prevent the consignor from doing this and that it would not be considered an advertisement.

E. R. CAMPBELL (C. I. I. St. Paul, Minn.): It would be an advertisement.

MR. NELSON: The exception taken to the card referred to by Mr. Mehan is rather technical, but I believe the rule plainly specifies that no trade mark will be permitted. The full name of the shipper is printed on this card, and underneath it is printed the words "Badger State Cement." The general opinion seems to be that the latter is equivalent to a trade mark and is superfluous.

MR. MEHAN: This shipper is much opposed to leaving that off and the traffic department have registered strong objections to forcing the issue.

MR. NELSON: It may be possible that the shipper has a large stock of these cards on hand, and if so, he should be permitted to exhaust them, but it seems to me that it would be entirely proper to insist on having the superfluous printing omitted on the new cards.

MR. SCHROEDER: I don't see what good it is going to do to put those cards on cars, because they are certainly not standard, and will undoubtedly be removed somewhere before the loaded car reaches destination.

MR. OWEN: This card is a standard size and conforms to the lettering on page 260, which says that the consignor may show name on the upper two-fifths, therefore, it appears to me that the removal of these cards is improper.

MR. MEHAN: All the lettering in question does not take up two-fifths of these cards.

W. R. ROGERS (C. I. I., Youngstown, Ohio): I venture to say that if your traffic department will go to interchange points and see what is happening to these routing cards, they will be glad to have the words, "Badger State Cement" omitted, which I believe should be done.

MR. OWEN: I believe this is an important question upon which some action should be taken. The shippers should be enlightened as to the kind of cards he may use, and we should be in a position to give them our

opinion as to whether or not they are right or wrong.

MR. O'DONNELL: In Buffalo we never ask anyone to take off any cards.

MR. SCHROEDER: That certainly will not remedy the situation, and it seems to me that we should all make an effort to remove cards from cars in accordance with the rules.

MR. O'DONNELL: Have you ever been penalized for them in our district?

MR. NELSON: It is of course, very undesirable to tip over backwards in matters of this kind, and while we are making an earnest effort to cope with the situation, we are at the same time trying to do so in a sensible manner, with the thought always in mind of working no particular hardship on anyone.

M. W. HALBERT (C. I. I., St. Louis, Mo.): In St. Louis we remove the placards with advertisements on them, but we do not penalize the railroads for doing so. We handle that with the shipper.

MR. O'DONNELL: Our superintendents are the people that should remove these cards, but when they want anything done, they put it on the car depai tment through the executive committee for protecting the delivering line.

MR. NELSON: The open confession made by my good associates, Mr. O'Donnell and Mr. Halbert, indicates beyond any doubt that they are working this matter along the lines of least resistance, and my reason for bringing this question up on this occasion is with the hope that we might agree to support the American Railway Association, because that association certainly does not go to a lot of trouble in establishing rules unless they intend them to mean something.

PRESIDENT JAMISON: We will pass on to the next rule.

Rule 60

J. M. RYAN (C. St. P. M. & O.): I am asking a question at this time in regard to cleaning air brakes. After the triple valve has passed the test rack test, it is often difficult to tell what the defect is. Is it necessary or compulsory to procure the test rack record and add it to the information of the original record as part of the billing repair card? I think some roads are doing that.

MR. SCHROEDER: I see absolutely no reason for doing so. Rule No. 9 does not require it.

MR. STARR: It may be thirty days before the valve is taken to the test rack. Therefore, a triple valve removed will have to be handled by serial number.

MR. BROWN: I understand that the Air Brake Association has a rule that in cases of slid flat wheels the brakes should be cleaned, regardless of the date last cleaned.

MR. OWEN: On a car with slid flat wheels where the triple valve does not pass the test, the record should show the triple valve defect and we should see to it that all points keep a condition record of any parts that cause slid flat wheels.

MR. RYAN: That question has come up within the last six weeks. We contend that it is not necessary to furnish the test record and refused to do so, and we just want to know if we are on the right track.

MR. HOYT: Item 164 of the air brake regulations states that all air brake connections and air hose must be tested with soap suds test where triple valve repairs are made. Is it necessary to do all that work?

C. W. KIMBALL (Southern): If the regulation require it there is nothing else to do and it should be done in order to know that brakes are in proper working condition.

MR. FITZGERALD: Several years ago the A.R.A. appointed a committee for the purpose of providing an average charge of $4.14 for cleaning triples. The idea was to eliminate the necessity of holding up billing record and compile data at your triple valve repair point, wasting time, and it is not now necessary to prepare such records. You now raise a question that tends to introduce a practice that was considered useless. If I repair a triple valve I render a bill against you immediately. I do not know whether it will pass on a test rack test or not. If a standard yard test develops that the brakes are inoperative, then you are permitted to render a bill and do not have to tell why it is inoperative and we do not have to maintain the record in question which we eliminated several years ago.

MR. BROWN: No records are kept of triple valves as to whether or not they pass the test on the test rack. We have a system of following up each triple valve to know who cleaned it. Air brake work is very important; you might clean a triple today and in 30 days have a little rust. If you do not keep a record of the test rack repairs, you do not know who did the work.

D. E. BELL (C. N.): Suppose you had a car placed on your rip track on account of being cornered, etc.. and found that the brakes had been last cleaned between nine and eleven months previously, would you feel justified in cleaning at the expense of the car owner?

MR. MEHAN: Rule 60 is very clear, you would clean the brakes and bill the car owner.

Rule 98

F. W. TRAPNELL (C. I. I., Kansas City, Mo.): Question No. 10: in the answer it says if the wheels are removed on account of worn through chill, etc., within 60 days of previous application, the initial charge for labor and material shall be withdrawn. Should joint evidence be made in such cases?

MR. OWEN: I think that interpretation is for the purpose of eliminating the use of wheels condemned by the re-mount gage, in fact, to get away from wheels that are almost worn out being applied to foreign cars and only running a short time.

MR. WHELAN: In connection with our own cars we are keeping a book record on all wheels removed, and if the wheels have been applied within 60 days we hold them for inspection by a representative of the company applying them, which we believe is the best way of proving that they did not last for 60 days.

MR. TRAPNELL: Sometimes your bills do not get to them until 60 days and you apply that wheel at your shop and even though you have got the utmost confidence in the men, I think the owner would be entitled to a joint statement.

MR. MEHAN: If that is to be done you would have to take joint evidence on every pair of worn wheels removed from cars.

MR. TRAPNELL: I understand.

PRESIDENT JAMISON: It seems to me that we will have to take joint evidence.

MR. FITZGERALD: You could not expect us to take joint evidence on every pair of wheels. The Arbitration Committee intended that you would have to accept the car owner's record.

W. SEHRS (I. U.): I want to know whether multiple wear steel wheels used in Vulcan trucks could be worn completely out and maintain the A.R.A. standard height of trucks from rails and also as set out by the Interstate Commerce Commission rules for use of locomotive tires.

MR. FITZGERALD: On the road I represent, we are now continuing an investigation in connection with truck conditions brought about due to multiple wear wheels

in Vulcan and similar type trucks where the wheels barely permit the truck frames to come within the clearance line of 2½ in. above the rail. This investigation was brought about due to the fact that in the application of Wharton rails located at railroad crossings we find marks of something coming in contact with them. Our investigation indicates that this condition is brought about due to these truck frames taking up the clearance due to worn wheel and while we have not yet completed our investigation, I assume we will in the near future make some report on this condition.

Horses made of scrap car material

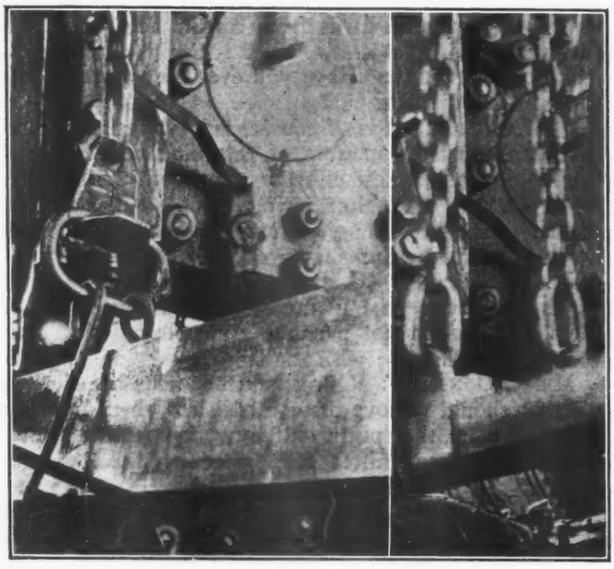
THE horses shown in the illustration are made of scrap channels, angles and sheets, removed from cars going through the shop. Their rugged construction insures a long life under hard usage. The weight, of course, makes horses of such construction impracticable to be carried around the shop, but they have proved to be especially serviceable in shops repairing cars by the spot system and where various parts, such as box car ends are assembled before being applied to the car.

Horses made of scrap car channels and angles

Homemade appliances aid in emergency car work

DURING an unusually busy time, at the Denver shops of the D. & R. G. W., a carload of center sills arrived to have the rivet holes punched, after which they were to be shipped to another division point for use in narrow gage cars. As the punch and shear machine is located in the middle of the steel shop, the sills could not be unloaded near it without interfering with the other work that was being done.

To facilitate the work of punching, the sills were piled at one end of the shop and carried to and from the machine by the overhead crane, balanced in two broad, stirrup-shaped hooks, which also held the sills while the holes in the face were being punched. When punching the edge of the sills, two hooks on a large ring were used to support the sills. The hooks were connected by a short section of ¾-in. by 2-in. bar, with a hole at each end to slip over the hooks. An 18-in. section of ¾-in. rod, bent back at one end to form a hook which just fits



Left—Rigging used to support the channels while punching the edge; Right—The channel carried in broad, stirrup-shaped hooks

the flange of the sills, was used by the operator to steady the sills while going through the machine.

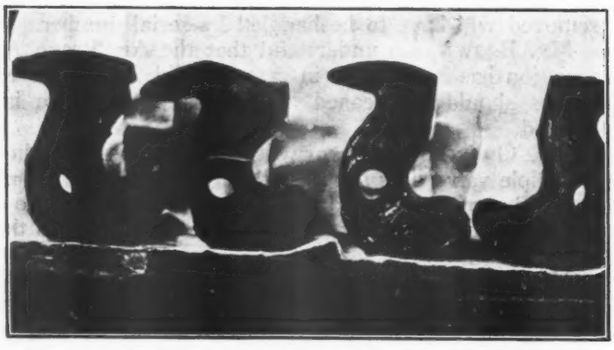
In this way three men, besides the crane operator, were able to handle the sills with ease; one man balancing and steadying the sills at the end, while another carman and helper operated the machine.

Reclaiming coupler knuckles

By J. E. Scott

General car foreman, Union Pacific, Cheyenne, Wyo.

ORDINARILY, a coupler knuckle is scrapped when the pulling face is worn beyond the gage limits. They can be successfully reclaimed by building up the pulling faces to the original contour by using oxyacetylene welding. In building up the pin holes and bringing them back to the original size and shape, the knuckles are preheated on both sides by the welding torch. Additional metal as needed is then welded on and then worked with a swedge until the gage requirements are met. This method has made it possible to replace knuckles in stock at about a third of the original cost.



Coupler knuckles reclaimed by the gas welding process

Rehabilitation of machine tools

Analyze policies to determine whether conditions warrant a program of modernization or replacement of old with new equipment

By Warren Ichler

"WELL, I certainly hope that this report will not be used as a basis for the purchasing of new machine tools for this shop," said the shop superintendent as he glanced through a newly completed governmental valuation inventory of the shop tools. "If it is used for that purpose I'll get no new machines for some time for you've been pretty enthusiastic about the condition of these 'antiques' we have here." "Cheer up, brother," retorted the field man of the valuation bureau who had made the inventory, "this data will not be used in making up mechanical budgets for many years probably, and you're getting along all right. You've modernized a lot of old machine tools until they are functioning very well indeed and this is said as a sincere compliment to you."

This conversation took place in a repair shop of a large western railway. On casual inspection the shop would seem to be a very dingy place, inadequate in every respect to serve the needs of even one division of a great railway system. In truth, it was one of the so-called secondary shops of the road, but was turning out a volume of work far above its apparent capacity. It had not been freshened with any deceptive air of smartness and newness by painting, white-washing or any other expedients used by shop supervisors in preparation for inspection parties. It had taken a rather close study of the various machines to detect the careful maintenance that had enabled them to continue in service for periods of from 10 to 25 years beyond what might normally have been expected from them.

What is there about the whole incident to give it any value whatever, over the dozens of casual contacts and the hundreds of inspections which the valuation inventory brought about? Was it because this shop had been fortunate in receiving extraordinarily good maintenance? Certainly not, for other shops have been well maintained, although this condition is not so general as to excite no comment. Rather, the matter is considered worth reporting because of the clear-cut, definite way in which a problem was met and solved—a problem which is probably a duplicate of the situation on many of the larger railway systems.

How results were obtained

Since the shop superintendent gave a clear-cut explanation of how he had achieved a fair degree of modernity with nothing as a basis but old, though well-built facilities, it seems best to let him state his shop upkeep program in his own language.

"I realized some years ago," continued the shop superintendent, "that this shop was to be relegated to a second-class position when the new shops were built and I also knew that this shop would have to repair increasingly heavier locomotives and cars without many additions of new machines. The new tools would go to the larger shops and we would receive the discards that had outlived their usefulness in the primary shops, not much better machinery than what we were then using. I am not criticizing that policy; I understand it is the usual procedure, but it was certainly up to me to get more out of the old machines than I had been getting and to be ready for heavier work when it came.

"The 'light' repairs that I would get in my secondary shop would get heavier instead of lighter. To tell the truth, I was afraid to present the case too strongly to the mechanical department officers. The economy slogan was being worked pretty hard and I was afraid I would get a deluge of relics from other shops no better equipped than the machines we already had, in lieu of the new machines wanted. It was better to try to recondition what we were familiar with than to expend a lot of effort on unfamiliar tools, or so it looked to me.

"With this decision as a starting point, we mapped out a program of what I call extraordinary maintenance; that is, not just replacements of broken or worn units in a machine, but a complete modernizing of that machine

with new units made of the best available materials and fitted with as high precision as possible.

"Every mechanic knows that the replacement of a cast iron change gear in a lathe with a similar cast iron gear, means no increase in the capacity of the lathe and every mechanic knows too, that there is a constant tendency toward overloading old machines in these days of high-speed tool steel.

"I have been learning some new expressions from you government men and since they seem to fit my needs I'll say that prior to our survey of our upkeep problem, we had made 'replacements in kind' instead of 'betterments'. After we had analyzed shop conditions and the work prospects, we scrapped that policy and went further. Not only did we use better materials and more careful workmanship, but we began to build up a reserve stock of repair parts in anticipation of failures of machine parts.

Machines set aside for rehabilitation

"However, we had not yet begun on the really constructive part of our program, which was to set aside one machine for reconditioning and modernizing and the keeping of one or two mechanics on that work until they became thoroughly acquainted with it and able to carry along with a minimum of supervision. Of course, we had a shop maintenance gang, but their time was largely occupied with emergency repairs and if they were not busied with shop repairs they were set at such work as scale repairing, pump refitting, etc. To offset this condition we took two of our best mechanics, explained matters to them, assigned them working quarters near the tool room and put into their hands all the catalog references or other data on the machines that we could find and after giving them an outline of what was wanted in repairing a specific machine, gave them that machine and told them to go to it. It was slow work at first. I think we managed to refit two lathes in the first nine months of the program, but after the men got the hang of what was wanted of them, they studied their job and became efficient. Then too, invention and research work came along with two discoveries that helped a lot. Invention conceived the idea of unit construction in a machine tool and we were able to fit some modern units such as quick-change gear boxes, improved aprons, etc., to old lathes and with autogenous welding to build up worn parts.

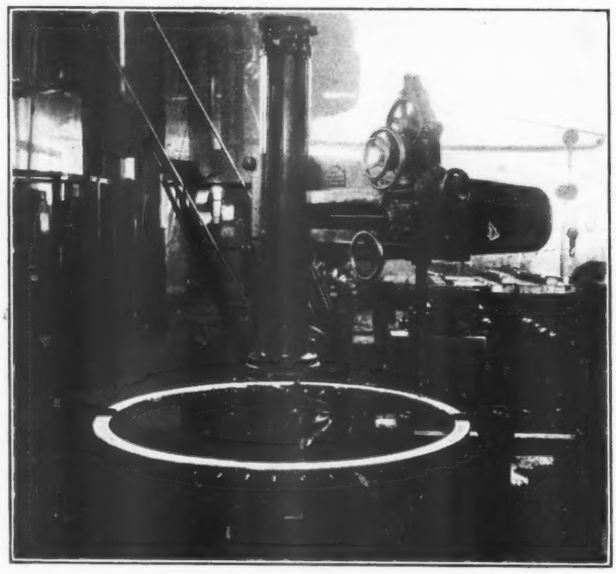
"Costly? Of course, it was costly at first and if supervisors had lost faith in the procedure or if most of us had been transferred to other points or had left the shop for any reason, all the ground work would have been lost. Fortunately, though, we carried it through and after the first year that this improvement scheme had been in operation, it is doubtful if any change in officers would have disturbed it. Its value to the road was so apparent that shipments of worn machinery came to us for rehabilitation and today this little secondary shop does nearly all of this work for the system, leaving the primary shops free for locomotive repairs.

All classes of machines repaired

"No, we did not forget the woodworker or the blacksmith or boilermaker in our program. It included their machines too, but of course there was much less volume of that kind of repairing than for the machine shop, and what there was involved very little modernizing of the machines. Now those are about all the significant points in the plan the working of which led you to pay me a compliment, which I appreciate, about my machine tools. First, analyze policies and see if conditions warrant a betterment and modernizing program or whether it would be better to depend on replacements of old with new machines. Second, if you decide on a betterment of existing facilities, don't waste time and energy and money on replacements in kind—make even your emergency repairs as lasting and modern as possible. Third, do not let your betterment work be hampered or sidetracked by confusion with other work, make it a separate and distinct function of a certain part of your organization. Fourth, and most important, make the men you put on this work feel that it is not just overhead expense, but that it is a very definite productive part of the necessary work of a railway shop."

Turn table for use on radial drills

ONE of the features of a radial drill of the design shown in the illustration is the wide area over which the spindle can be adjusted to suit various kinds of work. The fixture shown clamped to the bed of the drill is, however, an additional aid in drilling holes in large locomotive parts such as smoke box rings. It consists essentially of two 4-in. by 3-in. tees riveted together at the center, two adjustable clamps for holding the work and two wedge bolts for clamping the fixture to the table. Two adjustable plates and blocks are also provided for clamping the work in a vertical position.



Drilling a smoke box ring

The fixture is secured to the table by means of a tee-head bolt, the head of which fits in one of the tee slots in the bed. This bolt extends up through the center of the fixture and serves as a pivot when revolving the work. The fixture is clamped securely to the bed of the radial drill by means of the two wedge bolts, the heads of which also fit in one of the slots in the bed of the machine. The work is clamped to the fixture by means of two adjustable blocks and clamps, the ends of which are bent down to serve as a fulcrum. The work is revolved by removing the two wedges and wedge bolts.

Provision is also made for holding a smoke box ring in a vertical position while drilling holes in the outside circumference. The ring is clamped to the adjustable vertical plates shown at the center of the fixture, and the two blocks, one of which is shown, are placed under the sides to prevent the ring from rolling.

The west end of Russell yard as seen from the top of the sand house

C. & O. engine terminal at Russell, Kentucky

Designed particularly to handle a large number of Mallet locomotives with maximum terminal maintenance

WITHIN the last five years the Chesapeake & Ohio has been carrying out an extensive program of improvement to its mechanical facilities, one of the most important of which has been the development of the engine terminal at Russell, Ky. This terminal was placed in service about a year and a half ago and represents an effective combination of new and old facilities.

Bituminous coal constitutes approximately 85 per cent of the traffic handled by the C. & O. and at the present time this road handles the second largest volume of this commodity of any road in the country, amounting in the first five months of this year to an average of approximately 23,000 cars per week and representing from 10 to 15 per cent of the total bituminous coal car loading. Russell yard is the concentration point for the bulk of the great volume of coal traffic handled by the C. & O. and the engine terminal there despatches only freight and switching power for trains operating over four divisions out of Russell, each respectively 167, 132, 128, and 112 miles long. The terminal operations at Russell involve the handling of as many as 6,500 cars a day. During the month of October, 1926, the average number of freight units operated daily was 52 tonnage trains and 7 fast freight trains consisting of an average of 100 cars per train. To handle this traffic as well as to carry on local and yard operations it is necessary for Russell terminal to despatch from 93 to 104 locomotives in each 24-hr. period.

This terminal has been designed to handle a large number of freight locomotives of the Mallet type, the largest of which have an extreme wheel base over engine and tender of 105 ft. and a length over couplers of 115 ft. Not only has it been necessary to provide facilities especially adapted to the handling of this heavy power but, in addition, the terminal has been designed with the idea of providing a maximum of engine terminal maintenance between shoppings for general repairs. An important part of the maintenance work at this terminal consists of Class 4 and 5 repairs—an average of 12 locomotives per month being turned out after having received such classified repairs.

Terminal facilities

There are two separate enginehouses with a machine shop located between. One of these is the old enginehouse consisting of 22 stalls, seven of which are 70 ft. in length, two 90 ft. in length and the remaining 13, 115 ft. in length. The new enginehouse, located to the north of the old, has 14 stalls of 115 ft. in length, served by a 115-ft. Bethlehem twin-span balanced turntable. The distance between the centers of the turntable serving the new and old enginehouses is 700 ft. Provision has been made for the eventual expansion of the new house to a full circle.

In laying out the new terminal, two practically independent enginehouses have been provided, each served by a track layout providing for independent approaches,

ash handling and engine washing facilities. Under the new arrangement locomotives assigned to the handling of trains over divisions east-bound from Russell are handled in the old house while those for the western and northern divisions are handled in the new house. In view of the size and the number of locomotives handled, the track layout has been arranged with a view toward the elimination of terminal congestion and, as a consequence, covers a somewhat greater area than would be the case with a terminal despatching the same amount of power of a different type. One of the illustrations

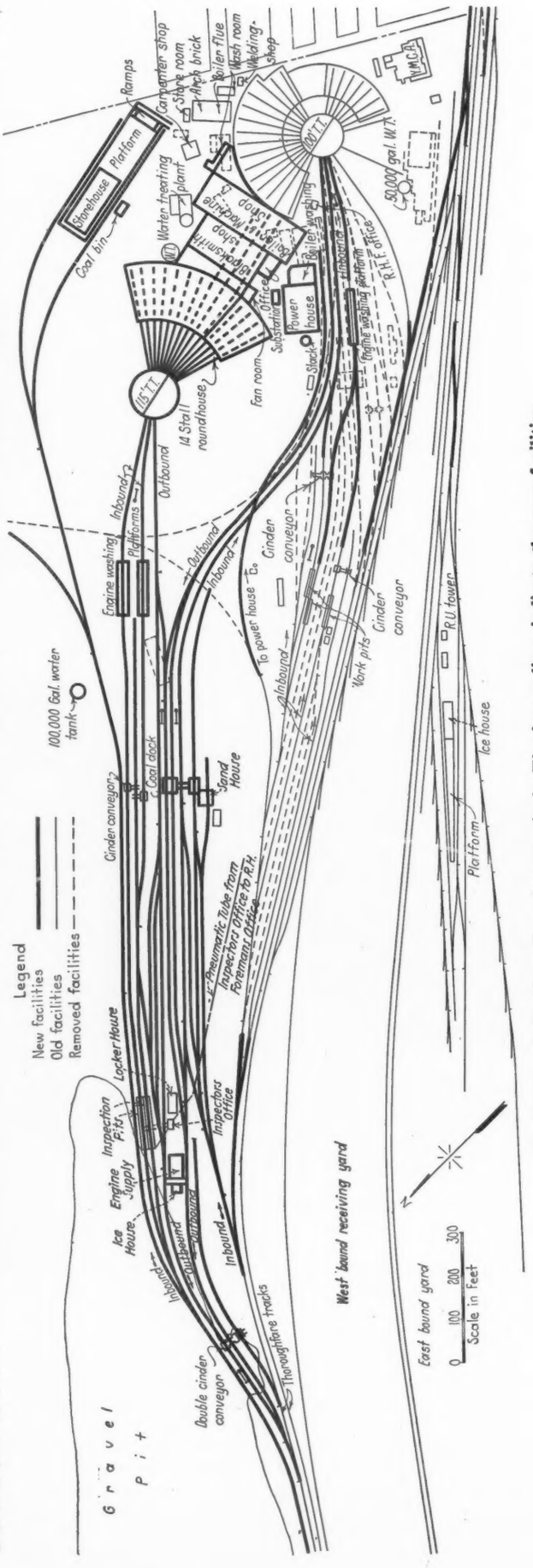
The inbound inspection pits are connected by a subway

shows the layout of the terminal. The heavier portions of the drawing indicate the new facilities. Likewise the heavier portions indicate in general that portion of the facilities now assigned to the handling of locomotives for trains over the western and northern divisions.

Locomotives coming into the terminal from trains arriving from the east pass over the inspection pits which are located adjacent to the engine supply house. It is approximately 900 ft. from there to the ash pits on the inbound tracks, which are located opposite the coaling station. The coaling station does not, however,

The coaling station and the sand house

serve the inbound track. From the ash pit to the engine washing platform is approximately 450 ft. The coaling station is located about 900 ft. from the center of the turntable serving the new house and about 1,500 ft. from the table serving the old house. Trains arriving from the east cut off and receive locomotives at the west end of Russell yard while trains arriving from the north and west proceed to the east end of the yard and cut off and receive locomotives at that point. In this way locomotives going to and from their respective



The layout of the Russell engine terminal—The heavy lines indicate the new facilities

enginehouses have about the same distance to cover at the terminal. Inbound tracks for both houses are served by cylinder handling plants of the Chillingworth type. The single track conveyors have 40 cu. ft. buckets and the double track conveyors have 80 cu. ft. buckets. A single double track cinder conveyor of the same type serves the two outbound tracks at the west end of the terminal yard.

The coaling station

The coaling station is of the mechanical type designed and erected by the Ogle Construction Company, Chicago. The storage pockets are of reinforced concrete, having a total capacity of 1,000 tons of coal and 25 tons of dry sand. The coal pockets are divided in three parts, having capacity for 650 tons of prepared stoker coal and 350 tons of lump coal. The coal chutes are so arranged that both grades of coal and dry sand may be delivered to locomotives on four tracks. The average daily distribution of coal for locomotive use is 866 tons while the maximum coal consumption during a 24-hr. period runs as high as 1,025 tons. To reduce the hazard of spontaneous combustion, the pockets are so proportioned that full storage capacity is obtained at a maximum coal depth of 24 ft. To further reduce this fire hazard, the pocket floors have a prevailing pitch of 10 in 12 and are so designed that the formation of "dead" pockets or piles is avoided.

The receiving hopper is of reinforced concrete, 24 ft. long by 16 ft. wide, under which is located a Jeffrey single roll adjustable crusher. Mine-run coal can be crushed to 4-in. size at the rate of 125 tons an hour, from which it flows by gravity to the elevating buckets, or it can be passed around the crusher and gravitate direct to elevating machinery. A shaker screen operated by a 10-hp. motor, is located at the top of the structure immediately beneath the discharge point of the elevating buckets. This screen is perforated with 2⅜-in. holes, staggered, and is so arranged that lump coal flows off either end into the two 175-ton pockets at each end of the storage bin and the fine coal, falling through the perforations, is delivered between the two lump pockets into the 650-ton stoker coal pocket.

The plant is equipped with balanced bucket coal handling machinery; two independent coal hoisting units are installed, each having a 25-hp. constant speed motor, an automatic reversing hoist and a 2½-ton automatic loader and self-dumping bucket. The hoist is of the mechanical control, steel geared, single drum type and is equipped with limit filling and dumping positions; a mechanical reversing mechanism, which, after a brief interval, reverses the travel of the drum when the bucket reaches either limit; and automatic slack cable release, which functions also as an auxiliary limit stop and a positive self-adjusting safety brake which engages the hoisting drum and prevents back travel of the loaded bucket, whenever any interruption to power application occurs.

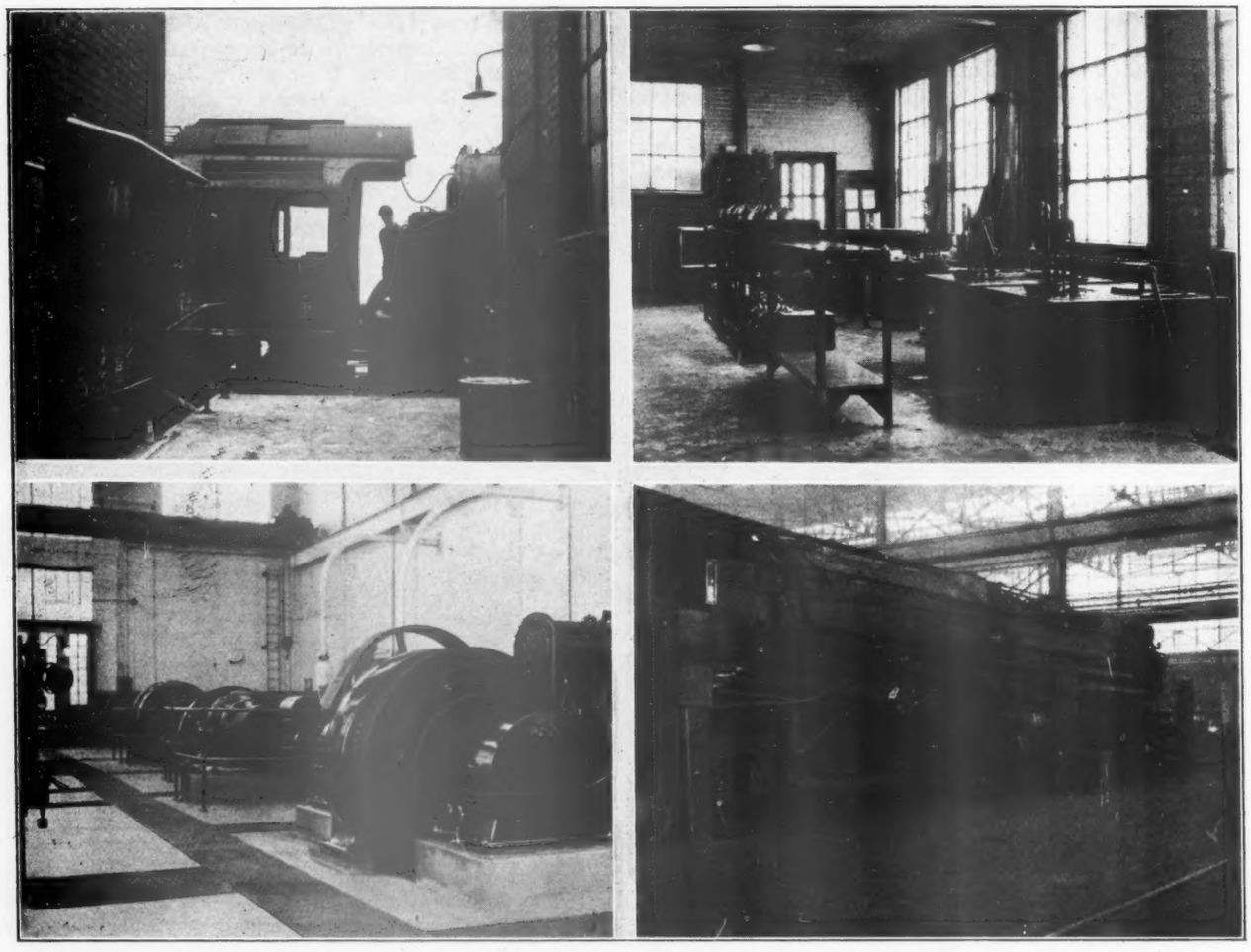
A 2-8-8-2 Mallet ready for wheeling

The loader is constructed entirely of steel plates and shapes, which operates automatically when the bucket it serves is in proper position to receive a charge. It so functions that a loaded bucket will not be reloaded should it, from any cause, return to the loading position before it has dumped. The bucket is a tight container, built of 5/16-in. steel plate, rides in a bale, on an inclined track and passes through dumping guides at the top of the structure to empty. This, in conjunction with the fact that it is well under the loader while being filled, obviates the spillage of coal in the pit.

Line switches in the machinery house are supplemented by remote control buttons placed at convenient points. The controls for the hoisting units, the crusher and for shaker screens are so interlocked that the bucket

hoists cannot be started until the shaker screen has been placed in operation and the crusher cannot be operated until the bucket hoists and shaker screens have been cut in. Conversely, if the shaker screen stops, the bucket hoists are automatically cut out and if the bucket hoists stop, the crusher is automatically cut out.

While the sand plant is a part of the entire facility it is provided with a separate receiving hopper and an independent hoisting unit. Wet sand is hoisted at the rate of 50 tons an hour by a 10-hp. constant speed motor, an automatic hoist and one one-ton self-dumping bucket and automatic loader. The wet sand storage bin is of reinforced concrete and of 250 tons capacity. After being elevated, wet sand is fed by gravity to four No. 1 Sutton sand stoves, which have a combined drying capacity of 40 tons in 24 hours. From the stoves, the dry sand gravitates through grading screens to two steel lift tanks from which it is pneumatically elevated to the 25-ton dry sand storage bin. This bin is of reinforced concrete, is an integral part of the main coal storage bin and is so located that dry sand flows by gravity through frost proof telescoping sand delivery spouts to locomotives on four tracks.



Upper left—The supply house platform is at deck level. Upper right—Interior of the oil house. Lower left—Engine room in the power plant. Lower right—A view of the Whiting 300-ton locomotive hoist

Supply house and water treating plant

At the engine supply house the tools and equipment are removed from the locomotives as they come into the terminal and on the outbound trip tools, supplies and oil are provided. The supply house platforms are located at the same height as the locomotive cab deck making it unnecessary for the men to climb up or down gangway steps. An ice house is located adjacent to the engine supply house and by means of coils in contact with the ice supply inside the house ice water is available for crews.

The inspection pits are located near the supply house, as are also housing facilities for inspectors and other outside employes. The inspection pits serving two inbound tracks leading to the new house are connected by a subway. It is the intention later to extend this subway to the inspector's office building so that it will be unnecessary to cross tracks in going to and from the inspection pits. A pneumatic tub system carries inspectors' reports to the general foreman's office at the enginehouse, a distance of about 2,000 ft. The washing platforms are 125 ft. in length and locomotives are cleaned by the D. & M. washing system.

Because of the character of the territory through which the C. & O. operates it has been necessary to provide extensive water treating facilities. The water supply for the Russell terminal is obtained from the Ohio River by an electrically operated centrifugal pumping plant with suitable intake provisions to care for widely fluctuating river stages. The raw water quality varies with the seasonal rainfall but has proved troublesome due to heavy sediment present during high river stage and the effect of acid coal mine drainage pollution during low water periods. The water is treated with lime

and soda ash to eliminate the scaling and corrosive properties and with sodium aluminate to assist in the removal of mud and sediment. These facilities consist of a constant rate chemical proportioner set at approximately 1,500 gal. per min., one sedimentation tank, 30 ft. in diameter by 80 ft. high and one combination sedimentation and storage tank 40 ft. in diameter by 76 ft. high, both tanks being equipped with downtake tubes and sludge removal systems. The daily water consumption will average at present about 1,500,000 gal. and there is a total available water storage of 1,100,000 gal.

Engine house facilities

The machine and erecting shop is located between the old and new enginehouses. One track provides through movement from the turntables of the old and new houses respectively. Four tracks in the new house are set aside for drop pit work—one track for engine truck and trailer wheels; the second for tender wheels and the remaining two for dropping driving wheels. The two tracks used for driving wheels are served by two Whiting motor operated drop tables. The engine and tender drop pits are served by four 15-ton Watson-Stillman hydro-pneumatic drop pit jacks.

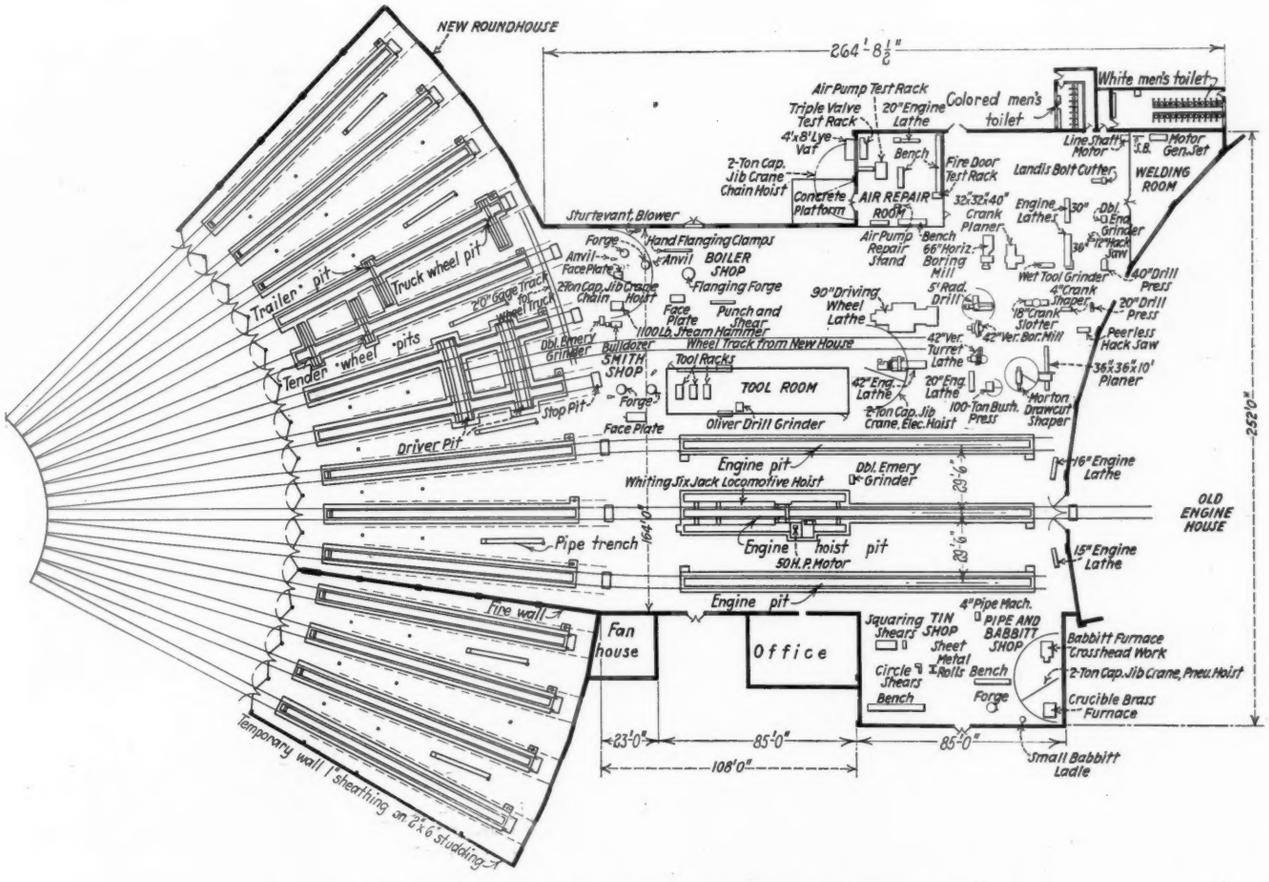
Excellent provision for the handling and transport of material in the new enginehouse has been provided by the location of monorail chain hoists, hand operated, located to serve both sides of a locomotive placed in the enginehouse stalls. The overhead monorail runs the full length of the stall and out into the circle. In this manner parts are brought out from alongside the locomotive by the monorail and handled from there by means of portable electric crane trucks to the various shops.

The enginehouse is heated by a hot blast system. A fan house adjoins the rear of the enginehouse and contains a steam driven multiblade fan and steam heating coil. Fresh air is taken into the fan through louvered openings in the fan house wall, passes through the heater stacks and is distributed by the fan through concrete and vitrified pipe ducts, to dampered outlets in the pits and in the rear enginehouse wall. Exhaust steam from the fan engine is piped to the heaters and augmented by exhaust steam from the power plant. The system may be used for summer ventilation by cutting out the heater and diverting exhaust steam through an exhaust head provided for that purpose.

All stalls of the new enginehouse are piped for a complete installation of the Miller boiler washing system and with direct steaming equipment installed by the Railway Engineering & Equipment Company, Chicago. For the firing of locomotives, shavings from the Huntington shops of the company are used.

Machine and erecting shop

The shop space is divided into two bays—one 108 ft. wide by 164 ft. long and the other of a minimum width of 85 ft. and 252 ft. long. Three working tracks from the new house extend into the shop area. All three of these tracks are equipped with working pits for nearly their full length. The middle one of the three tracks is the through track previously mentioned, running from turntable to turntable. On this track is located a 300-ton Whiting six-jack locomotive hoist. In the shorter bay is located the boiler shop, wheel shop and tool room. A



Layout of the shop showing the arrangement of machine tools

standard gage wheel track runs into the repair shop from the driving wheel drop pits.

That part of the shop space adjacent to the old enginehouse contains the pipe and tin shop, machine shop and air room. This part of the shop is served by a 15-ton single trolley traveling crane having an 82-ft. span and 30-ft. lift. One of the illustrations shows the location of machinery and the arrangement of the shop space while in Table I a list of the machine tools in the various departments is given.

The power plant

The boiler equipment of the power plant consists of four Stirling type Babcock & Wilcox water tube boilers equipped with automatic non-return valves and operating at 150-lb. pressure. The boilers have a total heating surface of 8,000 sq. ft. and are fired by Detroit underfeed stokers of the single retort type having a grate 6 ft. 6 in. long by 7 ft. 6 in. wide with a capacity of 4,500 lb. of coal per hour each. The stoker speeds and forced draft are automatically controlled and the furnace operation is recorded by Bailey meters. No superheaters are used. An overhead coal storage bin of 250 tons capacity is located in the boiler room. Coal cars, placed on a trestle outside of the power plant, dump into a receiving hopper underneath. The coal passes through a crusher and is conveyed by a skip hoist to the overhead storage bin. The average daily coal consumption of the plant is approximately seven tons for each boiler. At the present time the plant is normally operated at 75 per cent of its rating during the day and at 50 per cent during the night. Provision has been made for the installation of two additional boilers of the same or larger capacity.

Table I—List of machine tools

MACHINE SHOP

*90-in. Niles driving wheel lathe
*42-in. by 11-ft. 8-in. Futnam engine lathe
*20-in. by 4-ft. American engine lathe
36-in. by 6-ft. Schumaker & Baye engine lathe
30-in. by 4-ft. Pond engine lathe
18-in. by 6 ft. LeBlond engine lathe
*16-in. by 5-ft. Lehman engine lathe
*15-in. by 4-ft. 7-in. LeBlond engine lathe
*100-ton Chambersburg hydraulic press
36-in. RR type Morton draw-cut shaper
*36-in. by 36-in. by 10-ft. Cincinnati planer
*42-in. Bullard vertical turret lathe
*42-in. Niles boring mill
*No. 5 American radial drill
*18-in. Betts crank slotter
*66-in. Lucas horizontal boring machine
*32-in. by 32-in. by 40-in. Newton crank planer
*36-in. by 4-in. wet tool grinder
*13-in. by 16-in. Peerless hack saw
*2-in. Landis single head bolt cutter
24-in. Cincinnati shaper
12-in. Racine power hack
18-in. double end dry grinder—shop made
40-in. Niles vertical drill press
20-in. Barnes vertical drill press.

AIR ROOM

*20-in. by 5-ft. 6-in. Lodge & Shipley engine lathe
Fire door test rack
Air pump test and wash rack
Triple valve test rack No. 6 ET
Feed valve test rack
Distributing valve test rack.

PIPE AND TIN SHOP

*4-in. Oster pipe threading machine
Babbitt melting furnace
Brass melting furnace
Open blacksmith forge
2 large burring machines
Small burring machine
2 stove pipe crimpers
Stove pipe former
32-in. squaring shears
30-in. forming rolls
2 small turning machines
Wiring machine
Setting down machine
Beading machine
30-in. bar folder
20-in. bar folder.

BOILER SHOP

*10-in. punch, 24-in. shear, double end
12-ft. hand flanging clamps
5-ft. 6-in. dia. flanging forge
3-ft. by 6-ft. face plate

ELECTRIC SHOP

Motor generator set for battery charging and welding

CARPENTER SHOP

36-in. Oliver band saw

TOOL ROOM

*2¾-in. Oliver drill grinder

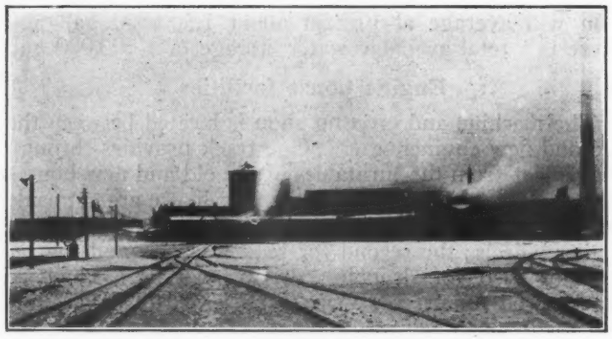
BLACKSMITH SHOP

*Sturtevant blower
4 4-ft. blacksmith forges and anvils
1,100 lb. Niles steam hammer
3-ft. by 6-ft. face plate
2-ft. by 2-ft. 8-in. face plate.

MISCELLANEOUS TOOLS

2 18-in. by 2½-in. Hisey-Wolf grinders

*Machine tools with individual motor drive.



Looking toward the new enginehouse from the coaling station—Washing platform at the left and tracks to the old enginehouse at the right

The ashes are removed by a steam jet conveyor to an overhead storage bin over a trestle outside of the power plant and loaded into cars by gravity. Each boiler is provided with an individual Wing steam turbine forced draft blower, automatically controlled by chronometer valves and regulator. Natural draft is provided in addition by a 175-ft. stack having a nominal diameter of 15 ft. at the base and 8 ft. at the top. The feed water for the boilers is heated in a Cochrane 1,500-hp. open type

The through track looking across the 300-ton hoist into the new enginehouse

heater and fed by two 10-in. by 6-in. by 12-in. Worthington duplex plunger type boiler feed pumps equipped with Fisher pump governors. Feed water regulations to the pumps is manually controlled. The boilers are equipped with Diamond soot blowers. Other mechanical facilities of the plant are as follows:

One 2,600 cu. ft. compound 20-in. by 12-in. by 16-in. Chicago Pneumatic air compressor direct connected to a 500-hp. 2,200-volt 3-phase, 60-cycle Westinghouse synchronous motor.

One 1,000 cu. ft. compound 13-in./21-in. by 22-in./14-in. by 18-in. duplex Laidlow-Dunn Gordon steam driven air compressor.

One 888 cu. ft. compound 19-in. by 16-in. by 12-in. by 16-in. Ingersoll-Rand air compressor, belt connected to a 152-hp. 480-volt, 3-phase, 60-cycle, General Electric slip ring motor.

One 1,000 g.p.m. 18-in. by 10-in. by 12-in. Worthington duplex Underwriters fire pump.

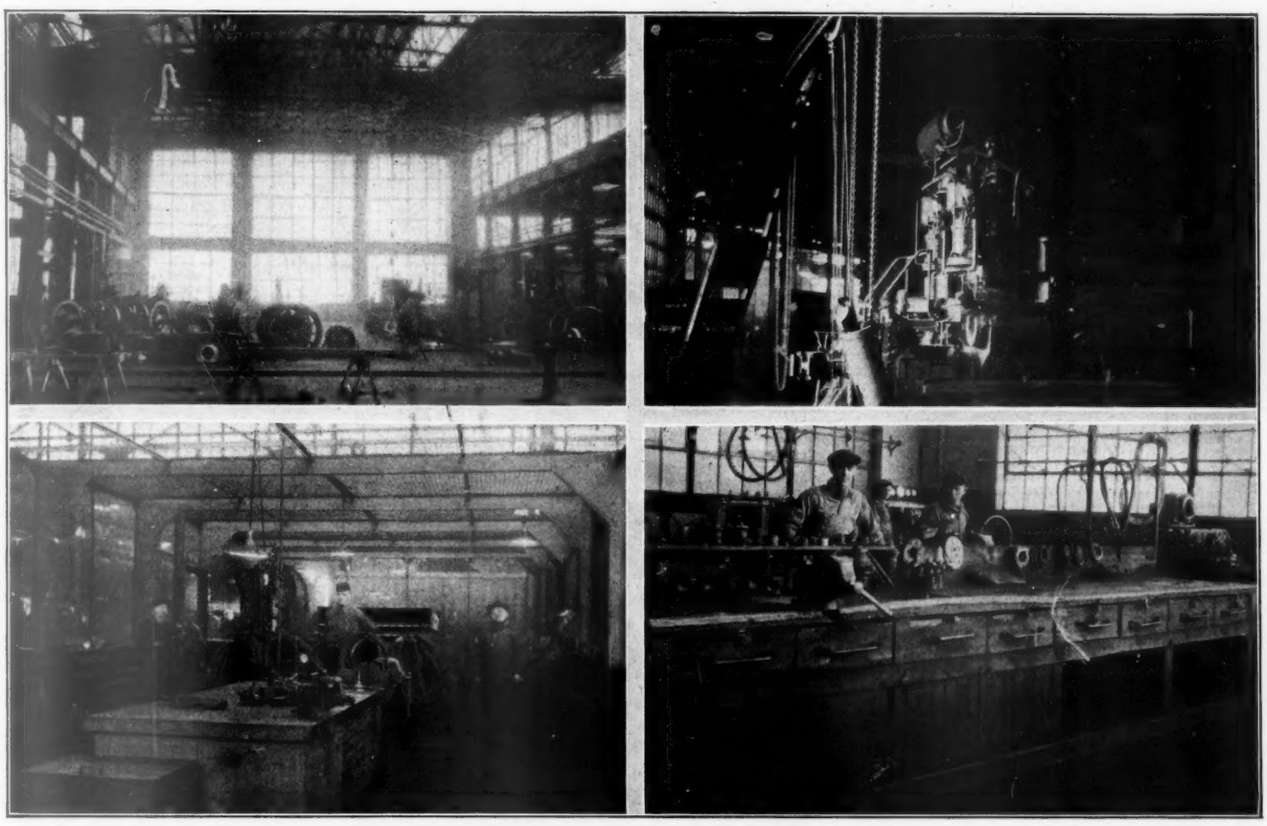
One 125-kw. 480-volt 150-amp. 60-cycle, 3-phase, 257-r.p.m. General Electric alternater direct connected to a 11-in. by 19-in. by 16-in. Ball compound horizontal steam engine.

Electric power supply

All electric current for the normal operation of this terminal is purchased. For emergency use in event of power shut-downs, a 125-kw. generator set is used as a standby unit for operating lights and turntable motors. The electric power and lighting is supplied by the Kentucky & West Virginia Power Company at 2,300 volts, 3-phase, 60 cycles, from a substation on the edge of the C. & O. property about 1,500 ft. from the power house, through two circuits of 500,000 c.m. cable on steel towers to the power plant substation between the enginehouse and power plant. This substation consists of three 666 kva 2,300/480-volt, power transformers, and one 100 kva 2,300/220-110-volt lighting transformer. The power company has three sources of power supply; from Kenova, W. Va., Cabin Creek, W. Va., and Philo, Ohio. An attendant is on duty at the main substation to change over from one to the other circuit in event of any trouble and save delays. The railroad company has a receiving panel and distribution panels in the power plant to distribute the power and lighting current to the shops and yards. The 2,300-volt supply line continues through the yards to the hump yards with substations taken off, one for coal dock operation and one for car shop operation.

The yard floodlighting is supplied by a separate three-phase, 2,300-volt line controlled by an oil circuit breaker switch at the power plant, with cutout switches and 2,300/220-110-volt transformers at each tower for individual control. For the interior lighting of the enginehouses elliptical angle reflectors are used for producing satisfactory illumination. RLM type reflectors are used in the shops and storehouse. The office lighting is by 200-watt Attalite luminaires which are also standard for station and Y. M. C. A. lighting.

The electric welding lines are wired through shops and enginehouses from a 35-kw. General Electric motor-generator set operating at 70-80 volts d.c. Portable panels are used around the shops for connecting to welding outlets. The panels are General Electric type DL 60 to 200 amps. mounted on warehouse trucks with boxes of supplies for the welder.



Upper left—Looking down the machine shop. Upper right—Parts are handled in the engine house by monorail hoists and portable electric cranes. Lower left—A view in the tool room. Lower right—Where air brake equipment is maintained

Enginehouse operation

The Russell engine terminal handles a monthly aver-

age of 220 locomotives for maintenance. The locomotives operating in manifest freight service are assigned, while other freight power is pooled. The practice of making periodical repairs is followed, an effort being made to perform such repair work at the time each locomotive is held out of service for monthly inspection and washout as will enable it to run until the next inspection period with a minimum of running repair work.

The repairs to locomotives in the enginehouse are made in accordance with the reports of inspection. Three separate work reports are made for each locomotive; one by the engineman who brought the locomotive in; one by an inbound locomotive inspector and a third, covering boiler work, by a boiler inspector. These three work reports are placed in metal cases which protect, under glass, the entire work report blank with the exception of the column in which mechanics who perform

THE CHESAPEAKE AND OHIO RAILWAY COMPANY

Form L. 94. Revised 1-1926. Pad 100 sheets

DAILY LOCOMOTIVE INSPECTION AND REPAIR REPORT

INITIALS | ENGINE NO. | INSPECTED AT | HOUR | DATE

Condition of injectors | Condition of Water glass | Condition of stoker | CONDITION OF PACKING: Throttle, Piston Rod, Valve Stem | BRAKES: Condition of air pump

Condition of gauge cocks | Condition of blowoff cocks | Condition of ash pan | Condition of whistle, " " Bell | " " Brake valves

Condition of lubricator | Condition of headlight generator | Do bearings run cool? | Driver brake pistons travel ____ in. Tender " " " ____ in.

Were emergency tools used? | Condition of sanders | Condition of Spark arrester | SAFETY VALVE | Main reservoir pressure ____ Lbs.

Does engine smoke? | Does engine steam? | Does Eng. throw fire? | Lifts at ____ Lbs. Seats at ____ Lbs. | Brakepipe " ____ Lbs. Leakage " ____ Lbs.

REPAIRS NEEDED	REPAIRS MADE BY
Boiler	
Machinery	
Air Brakes	
Cab and Boiler Fittings	
Piping	
Tender and Other Work	

Signature _____ Occupation _____

The above work has been performed except as noted, and this report is approved.

Engine ready to be fired up at ____ M. ____ 192__

_____ Foreman

Note—Use new line for each item of work.

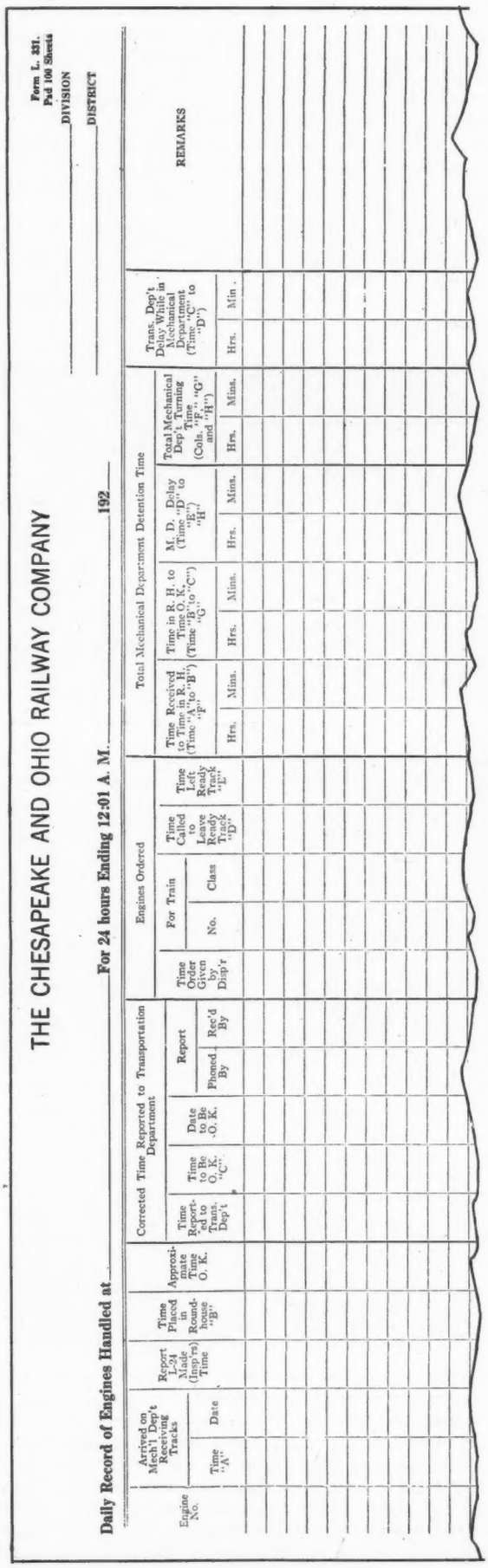
INSTRUCTIONS

Each locomotive and tender must be inspected after each trip or day's work and report on this form returned according to pairs or not.

Prompt explanation must be made herein for under failure to repair any defects reported, and the form approved by foreman before the locomotive is returned to service.

Inspection form used for reporting work and repairs made

the work indicated sign their names. These work reports are placed on the front of the locomotive and remain there until all of the work called for by the inspection reports has been completed. Specialized gangs of mechanics handle individual classes of repair work, going over the locomotives in the house and signing for their particular work as the different jobs on each locomotive are completed. Separate maintenance forces handle running and heavy repair work and in general separate forces handle the running repair work in the two enginehouses. The classified repair work is handled in the shop between the two enginehouses. In Table II figures are given for the entire year 1926 showing the number of locomotives handled at Russell terminal for the several classes of maintenance work required. Locomotives are withdrawn from service for shopping on a mileage basis, an anticipated mileage being assigned to each class of locomotive. It is, however, occasionally



Form L. 231. Pad 100 Sheets

THE CHESAPEAKE AND OHIO RAILWAY COMPANY

DIVISION _____ DISTRICT _____

Daily Record of Engines Handled at _____ For 24 hours Ending 12:01 A. M. _____ 192__

Engine No.	Arrived on Mech'l Dep't Receiving Tracks: Time "A"	Date	Report L-24 Made (Insp'rs) Time	Time Placed in Round-house "B"	Approximate Time O. K.	Corrected Time Reported to Transportation Department: Time Report-ed to Trans. Dep't	Time to Be O. K. "C"	Date to Be O. K.	Report: Phoned By	Rec'd By	Engines Ordered: Time Order Given by Disp'r	For Train: No.	Class	Time Called to Leave Ready Track "D"	Time Left Ready Track "E"	Total Mechanical Department Detention Time: Time Received to Time in R. H. (Time "A" to "B") Hrs.	Mins.	Time in R. H. to Time O. K. (Time "B" to "C") Hrs.	Mins.	M. D. Delay (Time "D" to "E") Hrs.	Mins.	Total Mechanical Dep't Time (Cols. "F," "G" and "H") Hrs.	Mins.	Trans. Dep't Delay While in Mechanical Department (Time "C" to "D") Hrs.	Min.	REMARKS

Form used for recording the movements of locomotives at terminals

necessary to shop locomotives before they complete the assigned mileage due to some particular condition of the locomotive. On the other hand, many locomotives are found to be in good condition upon the completion of their asigned mileage and frequently such locomotives are allowed to remain in service until their withdrawal is necessitated by required major repairs. During the year 1926 locomotives operated out of Russell terminal were able to make an average of 99 per cent of their assigned mileage. This represents the performance of motive power on four divisions, the individual percentages of actual mileage to assigned mileage of which were 91, 94, 95 and 116. In an effort to prevent engine failures, the various causes of such failures are recorded and analyzed. The following figures showing the cause and number of engine failures occurring to locomotives operating out of Russell terminal during the year 1926 are of interest:

Table II—No. of locomotive given repairs during year 1926

	Classified repairs	Certificate repairs	Turn-around repairs —less than 25 man-hours	Maintenance repairs other than certificate repairs	Heavy accident repairs	Boiler wash	Water change
January	17	111	3,264	86	..	410	52
February	10	116	2,790	98	..	401	59
March	14	114	3,041	89	1	413	54
April	8	118	2,757	100	..	413	43
May	16	121	3,126	96	..	412	54
June	12	117	2,804	115	..	424	86
July	20	128	2,777	81	..	412	84
August	12	107	2,843	90	..	406	136
September	9	118	2,866	84	..	411	98
October	4	110	2,974	94	..	404	159
November	10	106	2,921	87	5	411	91
December	19	114	2,838	94	..	412	77
Total	151	1,380	35,001	1,114	6	4,929	993
Av. per month	12	115	2,917	93	..	411	83

Cause	Number of failures during year
Flues or arch tubes leaking	4
Other leaks	6
Steam failures	3
Hot boxes	15
Hot pins	1
Crosshead failures	1
Eccentric strap failures	4
Stoker failures	11
Spring rigging failures	2
Failures from all other causes	115
Total	162

Investigation has developed the fact that in nearly every instance the stoker failures are due to foreign substances in the coal, such as mine car pins and miscellaneous pieces of metal scrap. During the year 1926 the Chesapeake & Ohio averaged 72,359 locomotive-miles for each engine failure.

A record of the engine terminal operation is summarized by the information shown on C. & O. Form L-331 shown in one of the illustrations. This form records the movement of locomotives from the time they arrive at the terminal until they are again despatched and pass into the jurisdiction of the transportation department. The information thus obtained provides a means of compiling average figures which are indicative of engine terminal efficiency. The averages for the Russell terminal are as follows:

1—Time from passing tower to time placed in enginehouse	1 hr. 25 min.
2—Time from arrival in enginehouse to repairs complete	3 hr. 10 min.
2A—Separate figure for locomotives in for washout	5 hr. 0 min.
3—Time from repairs complete to passing outbound tower	1 hr. 45 min.
4—Total transportation time (Items 1 and 3)	3 hr. 10 min.
5—Total of all terminal unproductive time (Items 2 and 4)	6 hr. 20 min.

Trepanning tool reduces machine time

THE illustration shows a tool that has been developed at the Burnham shops of the Denver & Rio Grande Western for use on a drilling machine for drilling out crank arms and link cheek plate pins. The work has been previously performed on a boring mill.

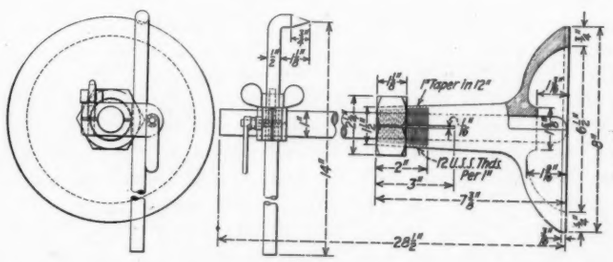
A three-blade drilling tool for machining crank arms and link cheek plate pins

The tool has three inside adjustable cutting blades securely held in a holder the shank of which fits in the standard drilling machine socket. This tool has reduced the machining time for these parts from 1½ hours to two hours, depending on the diameter of the holes drilled which vary from 2⅝ in. to 3¼ in.

Gage for setting eccentric arms

By E. A. Murray
Shop superintendent, Chesapeake & Ohio, Huntington, W. Va.

WHEN a locomotive receives class repairs, the crank arm is usually set in its old location as indicated by the keyway in the crank pin. But when the crank pin is renewed it is necessary to relocate the eccentric arm.



Gage for setting eccentric arms on locomotives equipped with Walschaert and Baker valve gears

The gage shown in the illustration has been found very accurate for setting the eccentric arm on locomotives equipped with Walschaert and Baker valve gears. When

using the gage, its base is placed against the main axle and the center rod of the gage pushed into the axle center. The point of the scriber is then adjusted to the required throw of the eccentric arm.

Superheater unit testing device

By L. V. Mallory
Division foreman, Missouri Pacific, Lexa, Ark.

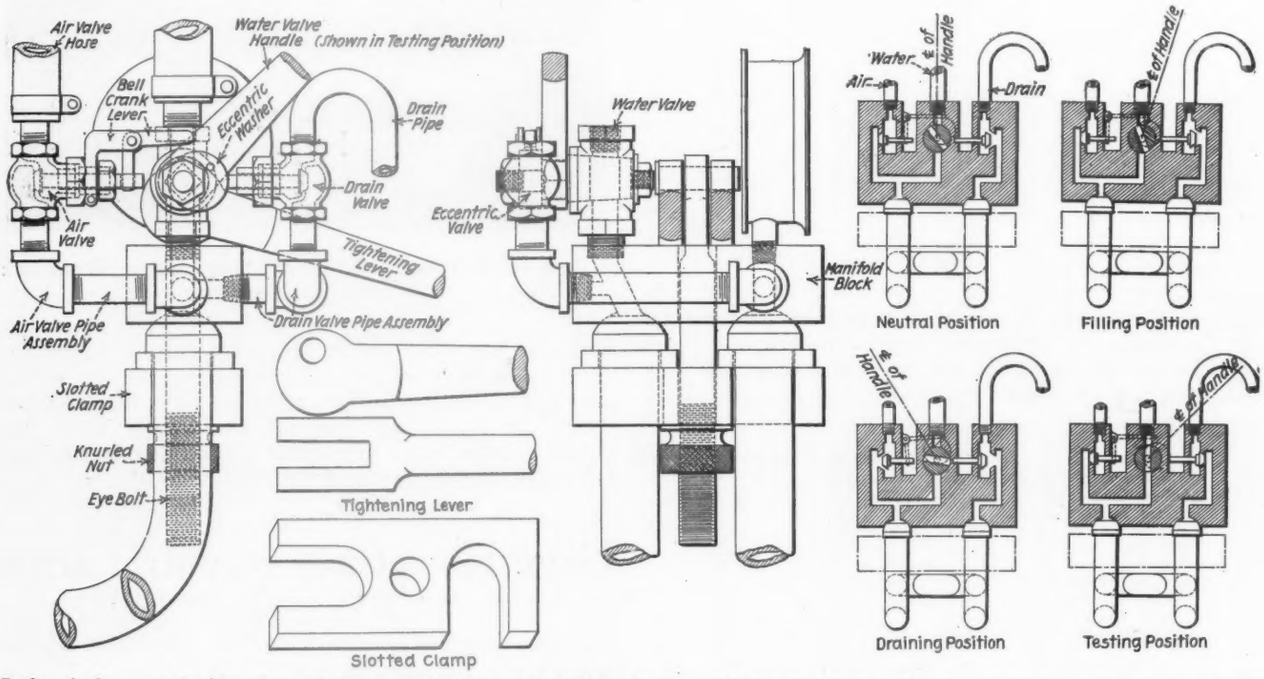
THE problem of testing and properly draining superheater units is often difficult to solve owing to the lack of adequate testing equipment. The proper draining of the units is important, particularly so in the winter, for if the water is not properly drained, it will freeze and burst the units. To eliminate this possibility, a superheater unit testing device has been designed by the author which besides testing, will effectively drain the units with the operation of a single lever.

The device consists of a manifold block which has two concave seats machined in its under surface that engage with the ball joints of the units. On the upper side of the manifold block and near the left end is drilled a hole that will tap to a ½-in. pipe thread to receive the water valve. A passage is drilled diagonally through the block connecting the concave seat with the water valve which is made of an ordinary ½-in. cut out cock. A small stud is set in the squared end of the gate plug of sufficient length to extend through the eccentric washer and engage with the nut used to secure the water valve handle to the gate plug of the water valve. The eccentric washer is so fixed to the water valve handle that its center line is at right angles and to the left of the vertical center line of water valve.

The air valve is next provided for by taking an ordinary ⅜-in. globe valve, reaming out smooth the inside threads in the bonnet and fitting it with a sliding stem in which is a small slot near its outer end to engage with the end of the bell crank lever. The lever is fulcrumed by a bracket clamped around the bonnet of the air valve immediately back of the packing nut. The valve is connected with the manifold block so that its stem is in horizontal alinement with the eccentric washer of the water valve. As the free end of the bell crank lever hangs directly above the washer, it is obvious that a movement of 90 deg. to the left with the water valve handle lever will cause the eccentric washer to deflect the bell crank lever, thus causing the air valve to open. The air valve is so connected with the pipe assembly that the pressure from the air valve hose is against the top or bonnet side of the valve.

A hole is drilled in the end of the manifold block to connect with the main water passage between the water valve and the ball seat. The outer end of this hole is tapped to receive the air pipe assembly, thus connecting the air valve with the manifold block at the delivery end. A hole is drilled vertically through the manifold block from the center of the ball seat at the discharge end. This hole is tapped on the upper side to receive a ¼-in. pipe fitting to which is attached a test pressure gage. Another hole is drilled at right angles to this passage and connecting with it from the front side of the block. This hole is tapped to receive the ⅜-in. nipple of the pipe assembly connecting with the drain valve. The drain valve is made of an ordinary ⅜-in. globe valve in the same manner as the air valve with the exception that the bonnet is cut off shorter and the packing nut eliminated and a shorter stemmed valve is used. This arrangement permits a more rigid construction of the drain pipe. The drain valve is so mounted on its connections that the valve stem lies in horizontal alinement with the eccentric washer of the water valve. The end of the valve stem is in contact with the circumference of the washer in the neutral, filling and testing positions of the water valve lever and the drain valve is closed.

A quick means of attaching and removing the unit is provided for by the use of a tightening lever, eye bolt, knurled nut and a slotted clamp. The tightening lever is of the cam type, the cam end being forked as shown



Left—A front and side view of the superheater unit testing device; Right—Sectional diagrams showing the events that take place with the different positions of the water valve handle

in the accompanying sketch, to engage with the eye bolt.

A liberal range of threads should also be used in making the one-inch bolt, for use with the different types of units. The slotted clamp is similar to the clamps used on the tool posts of large planers and boring mills. The slots are of sufficient width to saddle around the necks of the unit terminals. A 1 1/16 in. hole is drilled through the clamp between the slots. The knurled nut is made as large in diameter as the space between the necks of the unit will permit and is threaded 1 in. standard to engage with threads of the eye-bolt.

The throw of the eccentric cam of the tightening lever is such that when the lever is at the extreme end of the release position, the slotted clamp is lowered sufficiently to allow the manifold block to clear the ball joints of the unit terminals without disturbing the position of the knurled nut. This nut is used only in adjusting to suit units of different style.

The units can be handled to advantage by racking an entire set on a push-car just as they were removed from the locomotive, rolling them to some place in the shop or shop grounds where both compressed air and water pressure are available and connecting a short length of hose to the drain pipe leading to a pit or sewer opening, thus eliminating the usual mess attending such operations.

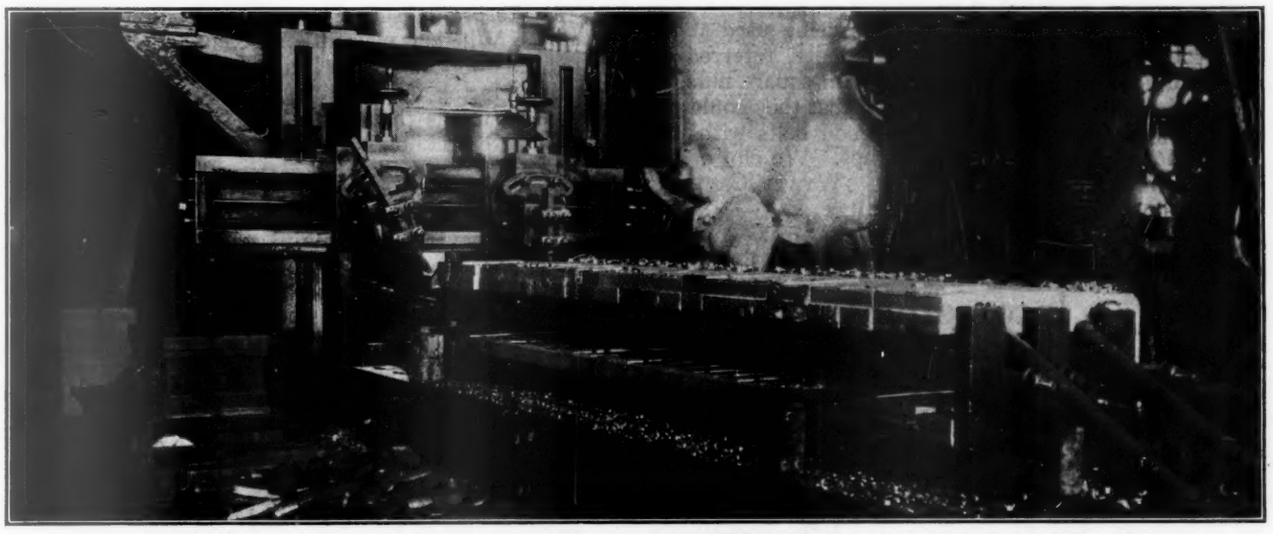
The device should be attached to the units of the bottom row first and worked toward the top. After the tester is attached to the unit and tightened, the water valve lever is moved a few degrees to the right from its original vertical or neutral position and held in this position until all the air is exhausted from the unit through the drain valve and a steady, solid stream of water flows from the drain pipe or hose. This indicates that the unit is free from air pockets and is ready for testing. As the unit is filled, the water valve lever is swung to the extreme right or testing position. This action opens wide the water valve and at the same time causes the eccentric washer to close the drain valve, causing a hydrostatic pressure to build up in the unit. The lever may be left in this position until the unit has been thoroughly inspected while under pressure.

The unit having been tested, the water valve lever is swung to extreme left, or the draining position. This action closes the water valve and at the same time causes the eccentric washer to engage with the bell crank lever, thus opening the air valve, admitting compressed air to the unit and forcing all the water out in an effective manner without disturbing the position of the units in their racked order. To remove the tester from the unit, the water valve lever is placed in its vertical or neutral position, which shuts off both the air and water. The tightening lever is now released.

The accompanying diagram clearly shows the sequence of events that take place with the different positions of the water valve handle. At points where insufficient water pressure is available, the pressure may be increased or "boosted" by opening the air valve by hand while in the testing position. The air pipe and drain pipe assemblies should be rigidly clamped or spot welded to the manifold block to maintain all valves in the proper alinement.

Machining main rod straps on the L. & N.

THE work of machining main rod straps at the South Louisville shops of the Louisville & Nashville is expedited by roughing out and finishing as many straps as possible at one time. In the case illustrated 24 straps for 7-in. crank pins are mounted on a Niles 32-in. by 32-in. by 14 ft. table planer and are being machined at one time, using the three planer heads simultaneously when this can be done to advantage. The first operation is to finish the oil cup sides of the straps with the horizontal rail heads while the strap ends are being cut off with a tool in the side head. The straps are then turned over and the bottoms and backs machined, also using all three heads. The straps are finished by machining the brass fits in a slotter, four straps being set up at a time for this operation.



Planing 24 back end main rod straps at one set-up in a Niles 32-in. by 32-in. by 14-ft. bed planer

THE TRACKLESS TRAIN.—The Mercury Manufacturing Company, Chicago, has issued three bulletins on its trailers for handling package freight or transporting materials in shops and roundhouses. Supplement to Bulletin A-100 describes the type A-610 trailer which is equipped with a fifth wheel steering arrangement, while the type A-570 trailer, with a self-dumping steel body for handling coal ashes, sand or other bulk materials is described in supplement to Bulletin A-125. The Mercury self-coupler which can be applied to any caster-type trailer, is fully described in Bulletin M-130. It is said these couplers will function through any angle of approach up to 60 deg.

The Reader's Page

Removing square nuts from steam hose clamps

ROCKY MOUNT, N. C.

TO THE EDITOR:

"Bill Brown's" comment appearing on page 512 of the July issue of the *Railway Mechanical Engineer* pertaining to a device for cutting hose bolts designed at the Emerson shops of the Atlantic Coast Line, was well taken, but we are of the opinion that he has not read the description of another device designed at the Emerson shops for removing hex nuts from bolts holding steam hose clamps. We have not yet been successful in removing square nuts from bolts with a motor operated machine. There is not room enough for a socket wrench on a square nut. If "Bill Brown" has such a device, we would be glad for him to illustrate it in some issue of the *Railway Mechanical Engineer*.

It is an easy proposition to remove or apply hex nuts with a motor-operated device such as being used at the Emerson shops. We use the bolt clipper, referred to, on steam hose bolts when equipped with square nuts, or in case the bolts are in such condition that they could not be used again. We do not scrap good bolts with hex nuts removed from steam hose clamps. We clip or cut all bolts from air or signal hose. WYATT CAVIN.

Another comment on stripping locomotives

BATTLE CREEK, Mich.

TO THE EDITOR:

I noted L. Showell's comment in the September issue of the *Railway Mechanical Engineer* in which he seems to be inclined to disagree with "Observer's" method of stripping locomotives, published in the August issue. Right or wrong, I believe that the procedure outlines by "Observer" has its merits. If I were dismantling the locomotives, they surely would be stripped for a complete overhauling. But, if I ran across rod brasses which were only 1/32 in. larger than the pin and the pin was in good condition and the brasses were also secure in the rods, it would be like throwing good money away to replace it. In many cases, one runs across motion which does not show any wear and will run out another mileage without needing repairs. Why waste all the extra expense overhauling it when you know you cannot better its condition?

Mr. Showell's letter dwelt strongly on renewing crown brasses. If your new crown brasses, finished, are 2 in. thick, you will probably have some old brasses in stock which fit snug in the box and can be rebored, maintaining a thickness of 1⅞ in. I cannot see where the ⅛ in. will throw enough additional weight on the new brass to overload it.

If a careful check was made of your driving springs, under load, I am sure one would easily find more than ⅛ in. variation in the contour of the springs.

A READER.

Shock absorption

MINDEN, La.

TO THE EDITOR:

When we speak of shock absorption
Contained in gears and trucks;
Consider, too, the foreman
And the various lines he bucks.
When the peak load falls upon him
He may bend but never break;
There really is no factor
Gaging punishment he may take.

He is a living bumping post,
Imbued with common sense;
Absorbing shocks without deflection
Whether plaintiff or defense.
Making mole-hills out of mountains
Is the fondest thing he's of;
Seems as though he really glories
In tackling problems hard to solve.

Whether given credit due him
Or it's absorbed by one above,
He never seems to give a hoot
If you praise him—or just shove.
When you compile percentage columns,
Do you slight him on your lists,
When he's fielding 'round a thousand
Do you call them all "assists"?

J. B. SEARLES.

Russian tests compare Diesel gear and electric locomotives

SCHENECTADY, N. Y.

TO THE EDITOR:

The Diesel locomotive with gear transmission and magnetic clutches, built in Germany for the Russian State Railways under the supervision of N. A. Dobrovolsky, and described in the May, 1927 issue of *Railway Mechanical Engineer,* was placed in service last March and since then has been moving freight between Moscow and Kursk, a distance of 331 miles.

During the first four months of service the crews became entirely familiar with the operation of the locomotive, in spite of the peculiarities of speed and tractive force control enumerated in the above article.

In view of the satisfactory results it was decided to make a long distance run between Moscow and Baku in the Caucasus, a distance of about 3,000 miles, in order to test the reliability of the locomotive in heavy continuous service, and also to try the results of various

alterations made in the locomotive after preliminary tests in Germany. It was further decided to make these runs simultaneously with the Diesel-electric locomotive described in the March, 1925 issue of the *Railway Mechanical Engineer*, as to get comparative results between two oil-engine locomotives with practically the same Diesel engines, but differing in the transmission.

The two locomotives left Moscow on last July 6 and 7, respectively; they arrived at Baku on July 14 and 15, left Baku for the return trip on July 17 and returned to Moscow on July 24. The locomotives were detained on their trips for various reasons, mostly for changing cars, for inspection of both locomotive and cars, and also for the cutting out and in of the dynamometer car which was occasionally used on various portions of the trips for either one or the other locomotive. As the two trains followed each other from two to eight hours apart, the coupling in and out of the dynamometer car required meeting of trains and caused considerable delay. In addition there were made several side trips with the locomotives in order to test them on heavy grades. One division between Prokhladnaia and Gudermes was covered by the two locomotives over two different lines of different length—the longer line had heavy grades. In the table which is given below the side trips are not included and for proper comparison the distance between Prokhladnaia and Gudermes must be excluded from the totals.

Results of comparative tests of the gear and the electric transmission locomotives

	Division	Distance in miles	Train tonnage (in tons of 2,000 lb.) locomotive		1,000 ton-miles locomotive		Oil consumption in lb. locomotive		Oil in lb. per 1,000 ton-miles locomotive		Average speed without stop locomotive	
			No. 2	No. 3	No. 2	No. 3	No. 2	No. 3	No. 2	No. 3	No. 2	No. 3
1	Moscow-Kursk	331	850	865	281	286	4,960	4,520	17.7	15.8	18.4	19.0
2	Kursk-Kharkov	152	785	852	119	129	2,190	1,770	18.3	13.7	17.4	18.6
3	Kharkov-Rostov	325	1,090	950	355	308	4,230	3,640	11.9	11.8	15.6	18.6
4	Rostov-Prokhladnaia	367	1,036	971	380	356	5,210	4,860	13.7	13.7	18.6	18.9
5	Prokhladnaia-Gudermes	112	1,020	.....	114	.....	895	.....	7.9	....	20.5	....
6	Prokhladnaia-Gudermes	141	.....	1,013	.....	143	.....	1,810	....	12.7	....	17.4
7	Gudermes-Derbent	157	1,010	1,105	159	173	1,930	1,960	12.2	11.3	21.8	17.4
8	Derbent-Baku	152	1,096	1,118	167	170	2,600	2,220	15.6	13.2	18.3	17.9
	Moscow-Baku (without trips 5 and 6)	1,484	985	959	1,461	1,422	21,120	18,970	14.4	13.3	18.0	18.6
9	Baku-Derbent	152	1,278	1,470	194	224	2,220	2,180	11.5	9.7	13.3	17.4
10	Derbent-Gudermes	157	1,322	1,470	208	231	2,320	2,610	10.7	11.3	18.3	16.8
11	Gudermes-Prokhladnaia	112	1,310	.....	147	.....	1,600	.....	10.9	....	19.2	....
12	Gudermes-Prokhladnaia	141	.....	1,470	.....	207	.....	2,800	....	13.5	....	12.3
13	Prokhladnaia-Rostov	367	1,322	1,443	485	530	5,240	4,780	10.8	9.0	17.6	17.9
14	Rostov-Kharkov	325	1,185	1,300	386	422	5,200	5,220	13.5	12.4	21.6	16.2
15	Kharkov-Kursk	152	1,185	1,300	180	198	2,090	2,140	11.6	10.8	21.2	18.5
16	Kursk-Moscow	331	1,185	1,300	392	430	4,960	4,880	12.7	11.4	18.6	19.0
	Baku-Moscow (without trips 11 and 12)	1,484	1,242	1,369	1,845	2,035	22,030	21,810	11.9	10.7	18.3	17.6
	Total	2,968	1,113	1,170	3,306	3,465	43,150	40,780	13.1	11.8	18.2	18.1

Note—Locomotive No. 2 has electric transmission; locomotive No. 3 has magnetic gear transmission.

Comparing the two Diesel locomotives it can be seen that locomotive No. 2 (electric transmission), made a total of 3,306 thousand gross ton-miles and consumed 43,150 lb. of oil, or 13.05 lb. of oil per 1,000 gross ton-miles; locomotive No. 3 (magnetic gear transmission) made, with trains of approximately the same tonnage and speed, over the same distance and under approximately the same weather conditions, 3,455 thousand gross ton-miles and consumed 40,780 lb. of oil, or an average of 11.81 lb. of oil per 1,000 gross ton-miles. This represents a saving of 9.5 per cent in favor of the Diesel locomotive with gear transmission, and is in conformity with the figures for efficiency obtained from stationary tests with the same locomotives, as given in *Railway Mechanical Engineer* for 1925, page 141, and 1927, page 273.

Oil burning steam locomotives in Russia consume with similar trains about 80 lb. of oil per 1,000 gross ton-miles, or from six to seven times as much as the Diesel engine locomotives.

A. LIPETZ.

What about draft gear maintenance?

NEW HAVEN, CONN.

TO THE EDITOR:

In response to your editorial in the November issue, entitled "What about draft gears?" I believe that all railroads should make an inspection of draft gears at least once every three years and that the date of the inspection should be stenciled on the end sill of each car. Furthermore, the A. R. A. should make it mandatory for all railroads to inspect the draft gears at stated intervals. It should also make provision in the rules to allow cars to be refused from the owners when this rule is not complied with.

With few exceptions, the average railroad does not repair draft gears unless there are visible defects, such as broken parts or excessive travel. It is my opinion that from 50 to 60 per cent of all broken knuckles, couplers, coupler yokes, buffer castings, draft arms, draft lugs, center sills and bolsters are caused by defective draft gears. No one can estimate the damage done to lading because of such a condition. There are also many cases where cars come out of the shop after receiving heavy repairs without having the draft gear lowered for inspection.

One of the greatest nuisances in the proper maintenance of draft gears is the man who lowers the pocket and finds a broken gear. Having no parts with which to repair the gear, he puts in a liner or shim to take up the excessive travel. Of course, he does take up the travel, but he also covers up the visible evidence of a defective gear. How long will the other attachments stand this before breaking? What chance has fragile lading in a car thus equipped? All railroad men know what a "rubber neck" is and all railroad car men usually know what causes this condition. What is the price of a draft gear part or even a complete gear, as compared with the cost of damage done to rolling stock and right of way when one of these "rubber necks" lets go in the middle of a hundred-car train running at 50 miles an hour?

There is only one way to improve draft gear conditions and that is to make the owners inspect these gears at stated intervals. If this is done, then watch the cost of maintenance of freight equipment and damage to lading decrease.

JAMES MCDONNELL.

Two Niles redesigned lathes for wheel shops

IN addition to the primary functions of turning journals, and facing hub liners on locomotive and trailer wheel axles, the 90-in. locomotive axle journal turning lathe built by the Niles Tool Works Company, division of the Niles-Bement-Pond Company, 111 Broadway, New York, is readily adaptable to receive a wide variety of attachments for other operations in connection with locomotive wheel sets.

Among these attachments perhaps the most frequently used are devices for the single or double quartering of wheels with crank pins 90 deg. apart. When these attachments are furnished, the utility of the machine may be further increased by the addition of crank pin turning and burnishing attachments, either single or double. These consist of revolving crank pin heads of the box tool type, each carrying two tools, mounted on special bases on the bed. The heads are clamped to the quartering spindles from which they receive their rotation and lateral adjustment. Burnishing tools with shanks arranged to fit the tool slots in the crank pin heads are regularly furnished to secure the desired finish after the turning operation.

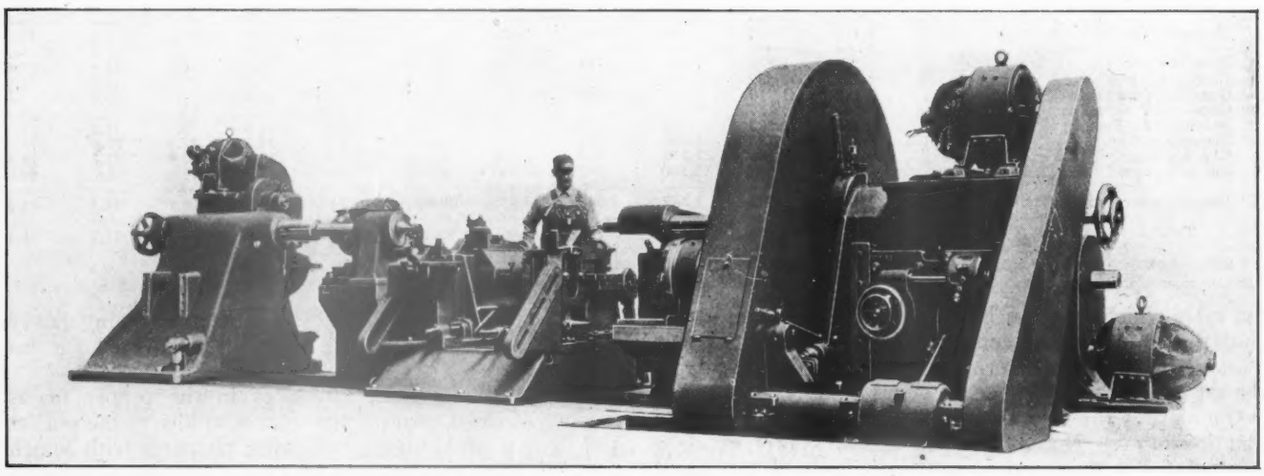


Fig. 1.—Rear view of a Niles machine arranged for both double quartering and crank pin turning of wheel sets with 90-deg. crank leads

Fig. 1 shows the rear view of a machine arranged for both double quartering and crank pin turning of wheel sets with 90 deg. crank leads. This illustration shows the set-up for wheel sets with right hand leads.

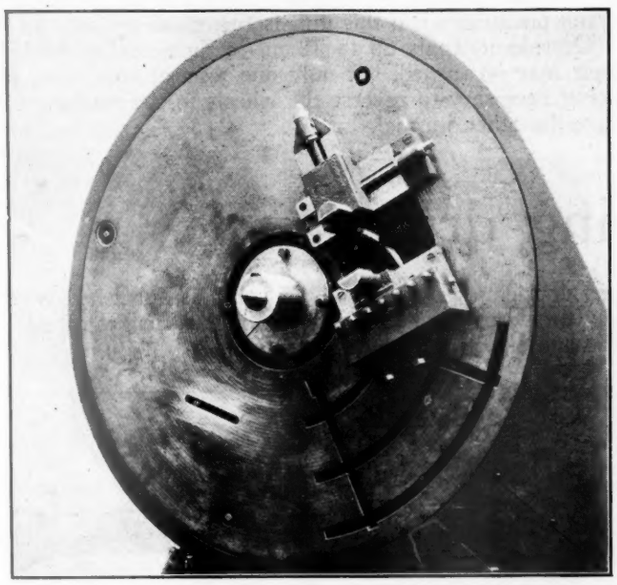
An exclusive feature of this machine is that the quartering and pin turning attachment for the tailstock or right hand head may be removed to the rear of this member, a pad being provided for its reception, which gives it the correct location, in conjunction with the left hand attachment, for double quartering or pin turning of wheels with left hand leads. An adjustment for engine strokes from 22 in. to 40 in. is provided in this mechanism.

For the quartering or pin turning operation the wheels are centered on the auxiliary centers and supported by two vee supports vertically adjustable by a screw and worm gearing. Each of these supports carries a slotted extension bracket to which the wheels are clamped when the correct radial setting has been obtained. This setting is facilitated by a turnbuckle link, one end of which is fastened to the wheel, the other to the bed.

The increasing adoption of three-cylinder locomotives on many railroads has made it necessary to modify the machine to accommodate wheel sets from these engines. To turn the journals of inside crank axles, a special rest with narrow slides may be furnished which is quickly interchangeable with the regular journal rest. Power feed movements also apply to the special rest. The two

journals may be turned at one setting without the necessity of reversing the wheels in the machine.

Instead of crank pins 90 deg. apart, three-cylinder engines have them 120 deg. apart so that the double crank pin turning or "quartering" of these wheel sets presents another problem. To meet this situation the base of tailstock quartering attachment is tilted by a 30 deg.



A new design of driver dog is now included in the Niles faceplate

wedge block which is the range of difference between cranks with 90 deg. and 120 deg. leads.

A lipping attachment for returning the outside diameter and lipping for the tire seat of mounted wheel centers can also be applied to these machines. It consists of a special rest having considerable transverse travel to handle wheel centers from 38 in. up to 72 in. or more in diameter. It is located near the faceplate and operates on one wheel center at a time. Power feed is available. the mechanism being connected to the main feed shaft. To secure slower speeds for this purpose an extra speed reduction is introduced in the face plate drive.

Crank pin grinding attachments and center crank pin turning attachments have also been developed to further increase the scope of the machine.

Fig. 2 shows a front view of the re-design machine arranged for journal turning on driving and trailer wheels. It has capacity to turn two journals at one setting up to 22 x ½ in. long and to face hub liners up to 24 in. in diameter.

To ensure journals true and round, the wheel sets are revolved on dead centers, the only rotating member being the faceplate which is carried on a large bronze bushing. The elimination of gear marks on finished journals has been attained by driving the faceplate by a belt, the faceplate acting merely in the combined capacity of a pulley and driving member to rotate the wheels. There are no rotating spindles subject to wear and sliding spindles carrying the centers can be locked in position for greater rigidity.

The drive is by a 15 hp. motor, either constant or variable speed. Mounted on the jackshaft at the rear of the machine is a friction clutch and gear box giving, when a constant speed motor is employed, four changes of faceplate speeds. The speeds are varied from the front of the machine by a clutch lever and a selective gear shift lever similar to automobile practice. When the drive is by a variable speed motor the faceplate speeds are increased or decreased electrically.

The drive from the motor to the jackshaft is through a belt 6 in. wide. The motor is mounted on slide rails so that the belt may be given the proper tension. From the jackshaft to the faceplate a belt 10 in. wide is used, the tension being secured automatically by an idler and spring. The belt circles about 270 deg. of the faceplate circumference. Completely enclosed in the face plate is a counterweight adjustable to suit the maximum counterbalancing of the heaviest wheel sets.

A powerful hand brake controlled by a lever conveniently located alongside the operator's position at the faceplate acts directly on the rim of the faceplate for stopping it in the most convenient position for putting in or taking out wheel sets.

A new design of driver dog which is in the nature of a two jaw chuck has been added to the faceplate. The jaws are tightened onto the crankpin and are lined with copper to prevent damaging the finish on the pins. For trailer wheels and driving wheel sets having no crank pins fitted an extension piece is clamped between the jaws, this piece projecting through the spokes or pin

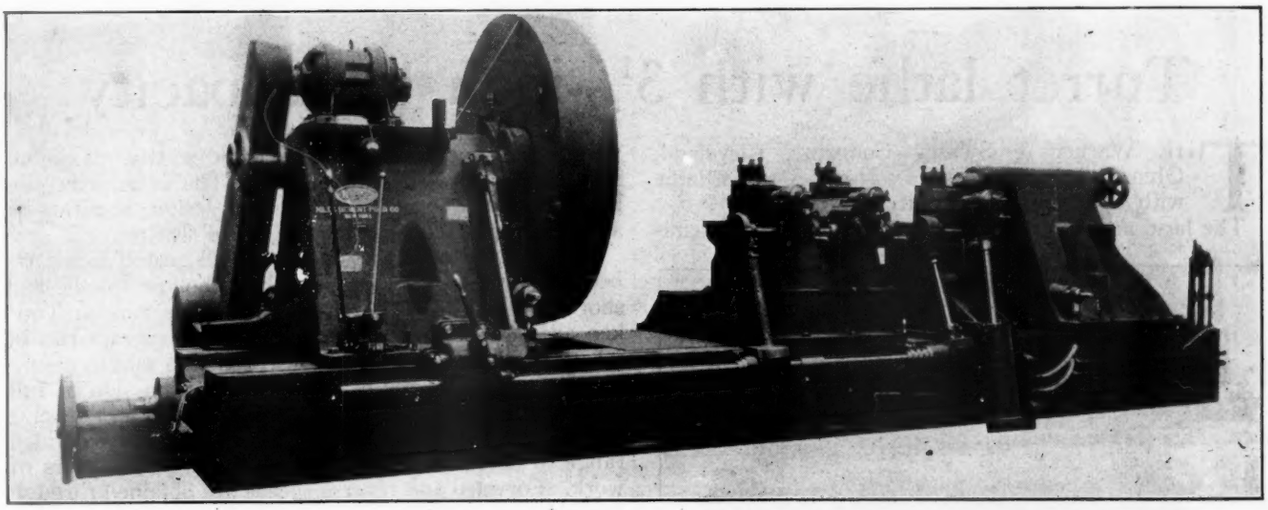


Fig. 2.—Front view of a Niles redesigned machine arranged for journal turning on driving and trailer wheels

hole to drive the wheel set. The chuck jaw type of driver is optional to the regular driver furnished which drives against the spokes of the wheel.

Both the headstock and tailstock are traversed along the bed by power, a 5 hp. motor being used for this purpose. Lateral adjustment is necessary for these members to manipulate the wheel sets in and out of the machine. Limit switches are provided which automatically shut off the power from the traverse motors when the heads have reached the limit of their travel. The heads are clamped to the bed by powerful eccentric clamps and may be clamped from either front or back of machine.

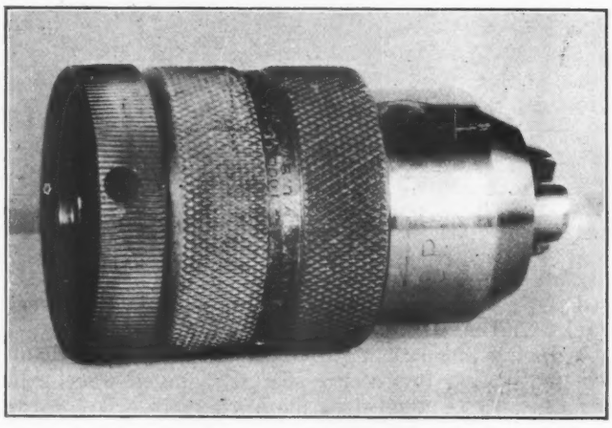
Feeds to the tool rests are independent and reversible and when an outside journal rest is furnished, a jaw clutch is introduced into the feed shaft to disconnect the feeding mechanism of the outside journal rest. The outside journal rest may be swung into position or out of the way when not in use, by a pneumatic cylinder. When swung out of position it in no way interferes with the free movement of the operator and the base to which it is fitted on the bed is used as a base for the revolving crank pin head when this unit is furnished.

Outside journals up to 12 in. in diameter by 16 in. long may be turned, but only one journal at a time, it being necessary to reverse the wheels in the machine to turn the other journal.

Keyless ball bearing drill chuck

THE Eastern Tube & Tool Company, Inc., 594 Johnson avenue, Brooklyn, N. Y., has placed on the market a chuck which is keyless, self-tightening and has a continuous grip. It does not depend on the operator to tighten it sufficiently to hold the drill. It is only necessary to close the chuck by hand. The chuck then takes its own grip after the work is started and as the drill point goes deeper. If more feed is used or a hard spot is struck, increasing the load on the chuck in any way, the chuck grip also increases. It is claimed that, no matter how tight the chuck grips, it can be released by hand by a quick twist of the wrist. Owing to the construction of the chuck, there is less slippage, which reduces the wear on the drill shank and on the jaws.

The new chuck has been designed for use on electric and air drills and can also be used to advantage on flexible shaft units. The holding collar at the top of the chuck is held by the operator to prevent the electric or air drill from turning when opening or closing the chuck. It also eliminates certain abuses electric drills are subject to, such as using a nail in the ventilating holes to prevent the armature from turning. This type of keyless drill chuck with a holding collar is furnished with any thread or taper to fit all the standard makes of electric and air drills now on the market.

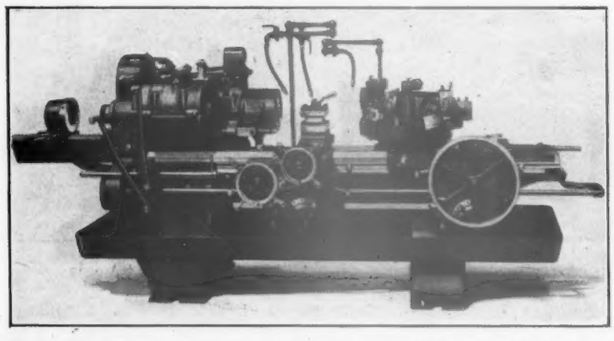


The holding collar at the top has been added to the Ettco keyless drill chuck

Turret lathe with 3½-inch bar capacity

THE Warner & Swasey Company, Cleveland, Ohio, has developed a new No. 3-A turret lathe with 3½ inch bar capacity.

The head and bed are cast solid in one piece of semi-



The new Warner & Swasey 3-A turret lathe, 3½-in. bar capacity

steel. The casting is uniformly hard, with a smooth bearing surface free from spongy iron. The ribbing and weight distribution has been arranged so that maximum stiffness is provided without bulk. The same principles have been incorporated in the entire design, resulting in an easily operated machine for large work.

The narrow construction of the all-geared head has been obtained by the use of a short, hollow spindle and short gear shafts. The shafts themselves run on Timken adjustable taper roller bearings. The gears run in a bath of oil. This type of construction is said to assure greater rigidity in the head and the transmission of full power from the driving pulley to the spindle. Twelve spindle speeds are provided, giving a finely divided range of surface speeds for small or large diameters of work. Forward and reverse speeds are obtained through friction cone clutches, so that all the other speeds are through sliding gears.

Bed ways of vee shape provide accurate alinement for both square and hexagon turret carriages. Patented way covers of heavy gage pressed steel completely enclose and protect these ways under every working condition, completely surrounding them, and excluding chips, grit, dust and dirt.

Warner & Swasey turret lathes with covered ways

have now been in successful operation for two years, and the claim is made that these way covers have provided complete protection to the bed vees and reduced wear on this important part to a minimum. Machines actually in operation for two years move with unusual freedom because of the absence of grit, dirt and dust, and the original scraper marks are said to be still visible on the vees.

The side carriage is of the Warner & Swasey type, permitting the taking of combined cuts from both turrets, and assuring proper rigidity for supporting square turret tools under heavy feeds. Sixteen longitudinal and cross feeds are provided for the side carriage, giving two overlapping ranges for hard and soft metal.

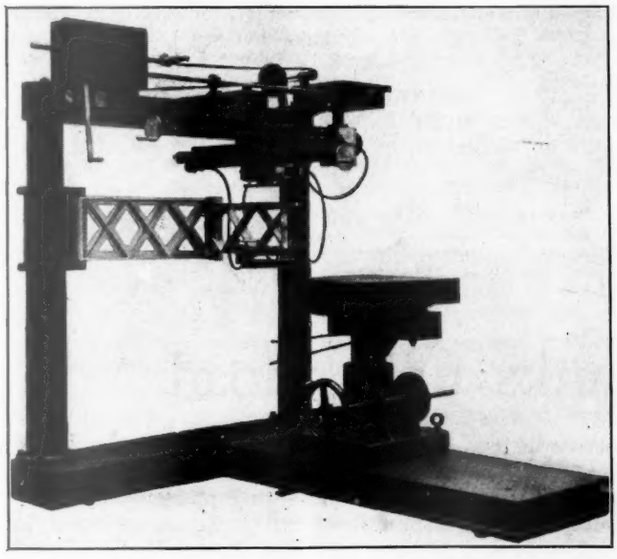
The hexagon turret carriage is provided with a circumference binder which clamps the turret rigidly to the saddle. The tools for the hexagon turret are bolted from the inside and centered by large projecting bosses, resulting in short overhang and rigid tooling. Sixteen right and left hand longitudinal feeds are provided for the hexagon turret. The power rapid traverse moves this turret back and forth.

The gear trains for both the square and hexagon turrets are all steel, properly hardened, and are of sufficient size to make possible extreme feeding pressures, especially for drilling. The carriages may be fed independently of each other, thus making it possible to use ideal feed under all circumstances. Special attention has been given to facility of operation in the No. 3-A, and all operating and feed levers are conveniently located. The machine is adapted also to chucking work and may be furnished with chucking and tooling equipment.

Godfrey oxygen jet cutting machine

THE Hubar-Jones Corporation, 13 Astor Place, New York, has introduced into this country the Godfrey universal oxygen jet cutting machine designed to cut circular, straight or irregular shapers automatically. Many of these machines, which were developed in England, have been installed in European railway shops.

The machine has been designed to produce accurate work and to provide flexibility of control. It is provided with a compound traversing main slide and a cross slide, with automatic feed screws, which can be operated

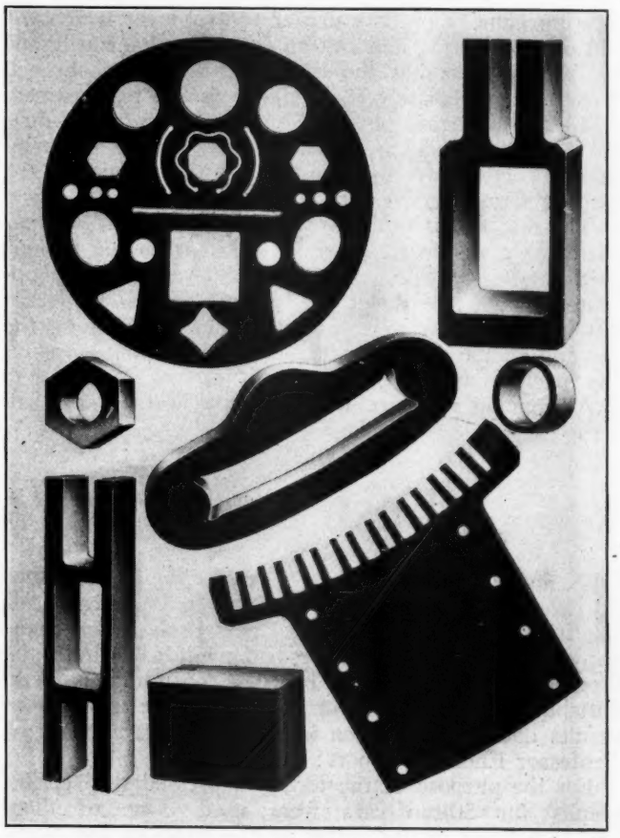


The Godfrey universal automatic oxygen jet cutting machine

manually as on a milling or slotting machine, enabling much work to be done without the use of a template. The machine will cut square or oblong holes from 1½ in. by 1½ in. up to 3 ft. by 3 ft. without a template. By using the trip actions on each traverse which automatically stops the cut at the required distance, the cut can be exactly duplicated without resetting. Both traversing slides and the rotary attachment on cross slide can be worked simultaneously.

The circular motion on the cross slide enables circular holes or blanks to be cut in plates from 1½ in. to 36 in., in diameter in graduations of 1/32 in. This circular attachment can be brought into correct position by the screw feed on the traversing slides. A removable graduated bar scaled in 1/32 in. controls the path of the torch so that it can be set to the size of hole required without the necessity of making any measurement.

A rotating table can be provided if required, which also serves as an adjustable work table that can be moved



A few of the shapes that may be cut on the Godfrey oxygen jet cutting machine

to any position relative to the machine, so that discs or holes up to 14 ft. in diameter or more can be cut. A bed plate is provided to carry the rotating table and keep it in exact alinement with the cutting machine. The table will rotate under a load up to eight tons. A mandrel fits into the center of the table, whereby collars,

cams, etc., can be quickly made. This mandrel is equipped to carry a template at the top, enabling irregular shapes to be cut. A division plate is arranged below the table which enables the operator to cut large square, hexagon or octagon nuts and other pieces without a template, also gear wheels, circular saw teeth and regularly spaced holes of any shape in any size of disc. For simple irregular shapes, templates can be made out of plywood. For complicated shapes each machine is equipped with a specially designed automatic attachment, together with a special machine for cutting compound plywood templates. These two devices greatly enlarge the scope of the machine and permit the carrying out of commercial designs which would otherwise be impracticable.

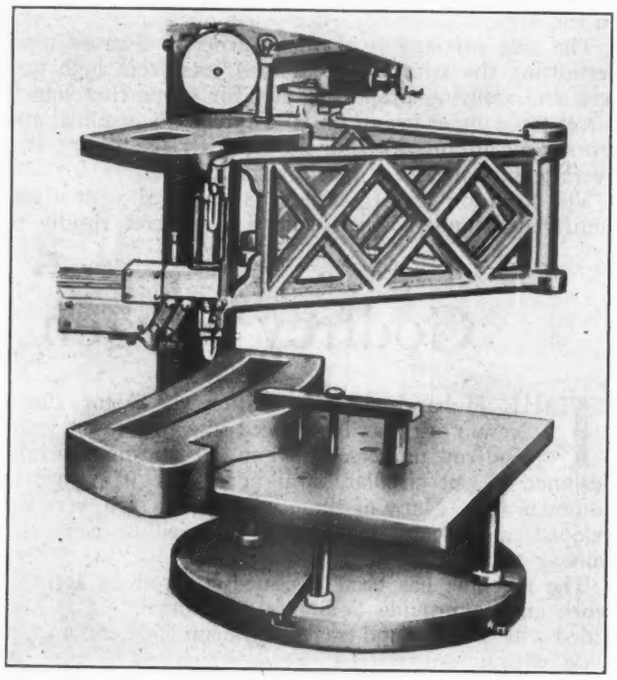
The machine is equipped with a specially designed high-pressure Godfrey cutting torch which is said to overcome the greatest disadvantage heretofore experienced in the cutting and shaping of metal by oxygen jet cutting, i. e., the necessity for subsequent annealing of all work so cut owing to the hardening of the metal in a zone at the cutting face. The essential feature of the torch is that the gases are thoroughly mixed before ignition.

The torch uses dissolved acetylene and will readily cut any thickness of steel up to 10 in. in a satisfactory manner. It is especially suitable for machine cutting and can be adjusted to any angle up to 45 deg. for bevel cutting. In addition to the valves for adjusting the heating flame, there is a master control lever which will cut off the heating and cutting flame simultaneously and by simply reversing the lever and relighting the jet, work can immediately be resumed without readjustment of the gas mixture. All the valves have graduated dials so that exact and known adjustments can be made instantly. Not only the pressure but the volume of the heating flame can be adjusted.

The machine is fitted with a friction type speed regulator to give the required variable speeds for various thicknesses of metal. The control lever is at the operator's hand and the speed can be changed while the cut is in progress. The operator can be watching the cut and alter the speed when necessary without stopping the machine or changing his position.

All moving parts are fitted with ball bearings and ball thrust washers; this minimizes friction to such an extent that a ¼-hp. electric motor will operate the machine, and insure very steady running without vibration, which is of the utmost importance to obtain smooth cuts.

A locomotive and ship building company of England conducted a series of tests to determine to what extent



Jointed arm and superimposed template for cutting locomotive links

the cutting flame hardened or damaged the steel. The data shown in the following table indicates that there were no weakening effects caused by the use of the cutting flame.

Test piece	Dia.	Area	Load	Per sq. in.	Elong. on 3 in.	Per cent
Normal bar cut by saw..	.798	.5	14.1	28.2	.93	31.0
Cut by oxy-acetlyene...	.977	.75	21.6	28.8	1.05	35.0
Cut by oxy-coal gas....	.977	.75	21.5	28.67	1.15	38.3

Test of spring planks under load

IN an effort to determine the effect of two holes that are required in spring planks for the application of its four-point support, the Davis Brake Beam Company, Pittsburgh, Pa., recently had a test made under the direction of Professor L. E. Endsley, consulting engineer, Pittsburgh, Pa. The method of making the test and the results obtained are given in the following abstract of Professor Endsley's report:

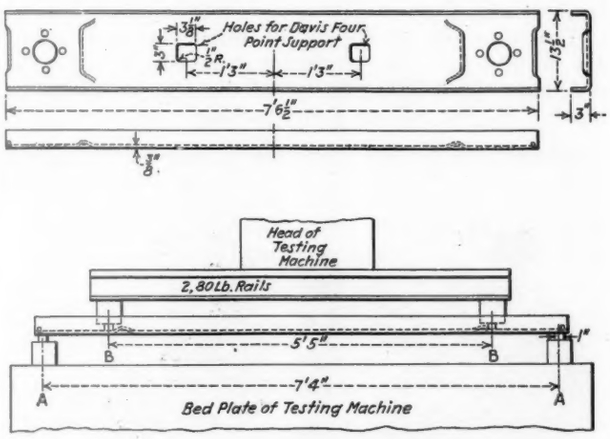
For the purpose of the test, two pressed steel spring planks for 50-ton cars were used. One of them had two holes in the center of the webb of the plank spaced equal distances from the center of the truck. These holes were the standard holes used for supporting the Davis Four Point Support. The spring planks were pressed out of ⅜-in. steel. A drawing of the spring planks tested is shown.

The method of testing was to support the spring plank at its extreme ends on the bed plate of the testing machine. The plank was supported at *A A* and loaded at *B B*. These supports were one inch wide and extended across the end of the plank and were 7 ft. 4 in. between centers. The load was then applied through two 80-lb. rails to the top side of the spring plank webb at two points equally distant from the center on supports one inch wide and 10 in. long. The distance between these points of applying the load was 5 ft. 5 in. The deflection was taken at the center of the spring plank by a micrometer coming in contact with a wire supported at the ends of the plank. Accuracy was obtained by the use of an electric bell. Readings were also taken across the two holes with a six-inch Berry strain gage, and the maximum stretch at the center of the hole and at one inch each side of the center was obtained.

The following table gives the results obtained. Column 1 gives the total load at *B B*. The other columns are self-explanatory. The readings taken across the centers of the holes with the six-inch Berry strain gage showed a stretch of .0006 in., which would be equivalent to 3,000 lb. stress if the hole were not there.

From the results it will be seen that the holes did not

weaken the spring plank, as the two tests are almost the same. Both planks took the first set at 9,000 lb. load, and both took the first appreciable set at 11,000 lb. load, and both stood 13,000 lb. with a little over ¼-in. set. While the spring plank with the holes stood a little better test than without the holes, the two tests are as close as could be expected of two planks made exactly the same, either with or without holes in them. A safe conclusion is that the holes in the spring plank have no effect upon its strength.



The method of testing the spring planks

Results of the spring plant tests

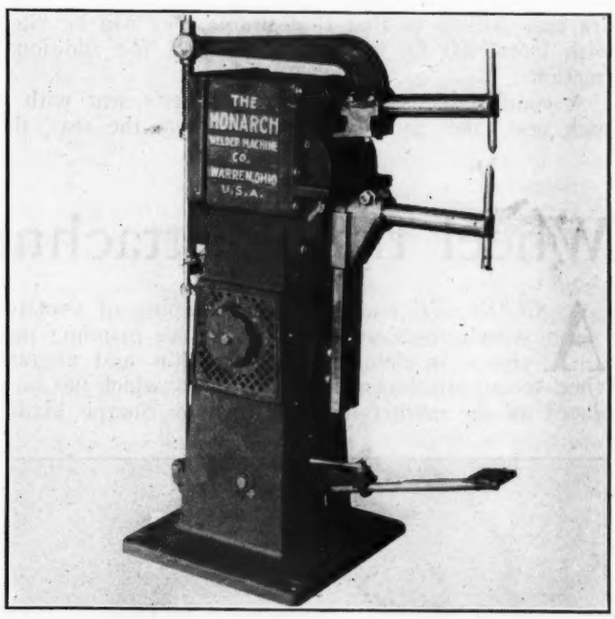
Load in lb.	Spring plank with no holes		Spring plank with two holes for Davis four-point support	
	Deflection, in.	Set, in.	Deflection, in.	Set, in.
1	2	3	4	5
1,000	.000	.000	.000	.000
2,000	.050	.000	.044	.000
3,000	.098	.000	.090	.000
4,000	.144	.000	.137	.000
5,000	.192	.000	.187	.000
6,000	.240	.000	.231	.000
7,000	.288	.000	.275	.000
8,000	.336	.000	.330	.000
9,000	.385	.001	.373	.002
10,000	.432	.005	.417	.005
11,000	.504	.043	.488	.041
12,000	.634	.106	.627	.104
13,000	.901	.314	.819	.284

Monarch spot welder

THE Monarch Welder Machine Company, Warren Ohio, developed the spot welding machine shown in the illustration with simplicity of construction and operation as the principal features. The main frame is a one-piece casting. The upper conductor arm in supported by a fulcrum bracket cast as a part of the frame which provides a four-inch fulcrum bearing. The lower conductor arm, of two-inch hard drawn copper, is supported by a pure cast copper slide bracket which is movable and adjustable on a one-piece pure copper bracket slide four inches wide and one inch thick. This slide has a tee-slot machined the full length which takes a ⅝-in. tee-bolt. The lower bracket may be set at any desired position by loosening the nut on the tee-bolt.

Several different combinations of electrode positions are provided to simplify welding on a variety of work. The lower conductor slide bracket may be moved 20 in. on the slide, which permits the use of varying lengths of electrode point holders. The upper conductor is held in the arm by four clamp bolts while a single clamp bolt holds the lower conductor in the slide bracket. The point holders are used in a vertical position when set in one end of the upper and lower conductors, while by reversing the position of these conductors end for end, the point holders may be set at any angle up to and including 30 deg.

The current is controlled by a switch located on the back of the machine and connected to a foot treadle. In operation the treadle has, in effect, three positions: the first pressure clamps the work; the second closes the circuit and makes the weld while the additional pressure on the treadle causes the switch to open the circuit and cut off the current while the pressure on the welding points still holds the work. This feature allows the weld to set thoroughly before the parts are released. The foot treadle can be swiveled so that the operator may work either in front of or at the side of the machine. This welder operates on single phase 60-cycle alternating current at 220 or 440 volts. The transformer capacity is 8 kva. and voltage regulation is provided in eight equal steps to care for the variation in voltage requirements for different gages of material as well as to increase the welding speed. The machine occupies a floor space of 20 in. by 20 in., is 48 in. high and weighs 615 lb.



Spot welder with adjustable electrodes and electrode arms and three-position treadle control

SMOOTH FINISH MACHINING OF LOW CARBON PLAIN AND ALLOY STEELS.—This is a reprint of a paper from the Transactions of the American Society for Steel Treating which is being distributed by the International Nickel Company, New York. It is a practical explanation of correct shop practice for obtaining a smooth finish on plain and alloy steels by avoiding the critical range in volume removal rates which varies for different steels.

An industrial tractor for general shop use

THE J. I. Case Threshing Machine Company, Racine, Wis., has recently placed on the market an industrial tractor intended for use in railroad shops and freight terminals. The machine has been built compact and low for working in close quarters. The unit can go through gates and doorways, up ramps and on elevators where it would be difficult for a larger machine to operate. The machine has great stability because of its low center of gravity. It can go up steep slopes and under low overhanging obstructions, as there are no parts projecting up over the tractor.

Not only have the designers made this tractor very compact, but they have also designed it so that it can turn completely in a radius of 10 ft., which is an important feature when working in cramped quarters.

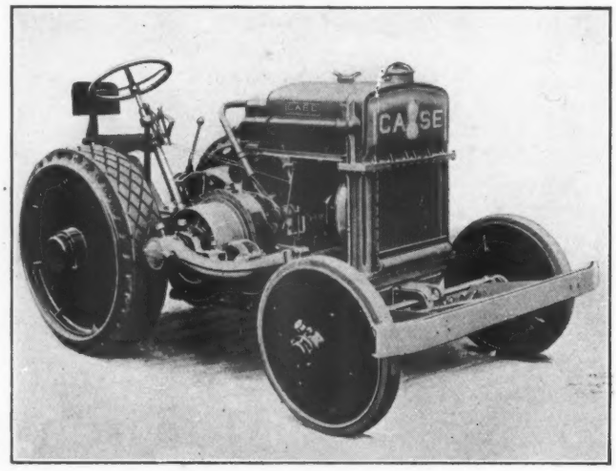
The tractor is rated at 12 hp. on the drawbar and 20 hp. on the belt, with an abundance of surplus power for emergencies. Equipped as it is with a belt pulley, it is always ready for a belt job as well as a drawbar task. A quick-acting, throttling governor regulates the speed of the engine to meet any variations in load.

As much of the work of a tractor is on the floors of buildings, platforms, decks, docks, ramps and pavements, this tractor obtains its traction by the weight on the rubber tired wheels. They also have good traction on slippery or loose surfaces.

The weight of the tractor is so divided that approximately two-thirds is carried by the rear wheels. These are cast hollow so that if desirable they can be filled with from 400 lb. to 500 lb. of sand for additional traction.

A comfortable spring-mounted driver's seat with a back rest takes up road shocks. From the seat, the driver commands a good view all around as well as straight ahead.

The bore and stroke of the four-cylinder engine is 4⅛ in. by 5 in. The maximum speed is 4.23 m.p.h., the minimum speed 3.06 m.p.h. and the reverse speed 2.21 m.p.h. A gear type oil pump furnishes force feed lubri-

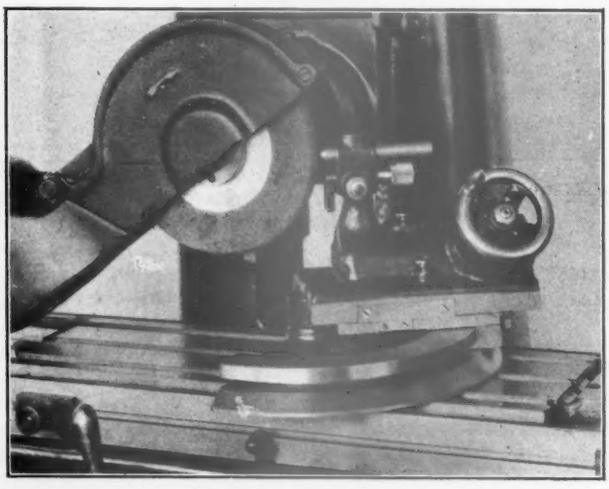


The Case industrial tractor

bation to the connecting rod and camshaft bearings and governor parts. The transmission, fan gears and steering gear run in an oil bath. A twin disk clutch is used. The clutch pulley brake is operated by the clutch lever, facilitating gear shifting and serving as a tractor brake when the transmission gears are in mesh.

Wheel truing attachment for surface grinders

ACCURATE and economical shaping of abrasive wheels used on its No. 2 surface grinding machines is claimed for the radius and angular wheel-truing attachment here illustrated, which has been placed on the market by the Brown & Sharpe Manufacturing Company, located at Providence, R. I.



The attachment in use shaping a radial contour on the periphery of the surface grinder wheel

With this attachment, both convex and concave outlines having radii varying from zero to 1 in., and face angles up to 90 deg., either side of zero, can be formed. A number of combinations of radial and angular shapes, otherwise difficult to obtain, can also be developed conveniently. The attachment is particularly desirable when grinding lamination dies, flat forming tools and miscellaneous pieces of material circular or angular in form.

The attachment uses a diamond tool which is clamped in an upright post on a movable slide. The slide is graduated for fine adjustment and can be locked in position by a clamping screw. A gib and adjusting screws provide the means of compensating for wear. The slide is carried in a swivel which pivots on a hardened steel stud and can be securely clamped in any position desired. The base upon which the swivel is mounted is graduated to 90 degrees either side of zero.

Convex and concave shapes are secured by clamping the slide at the desired radius and swinging the swivel through an arc sufficient to develop the full outline. Angular faces are obtained by clamping the swivel at the desired angle and then passing the slide back and forth by a handwheel, the diamond tool being held in the holder at right angles to the slide. The center line

of the abrasive wheel is brought in all cases to the same height as that of the diamond tool.

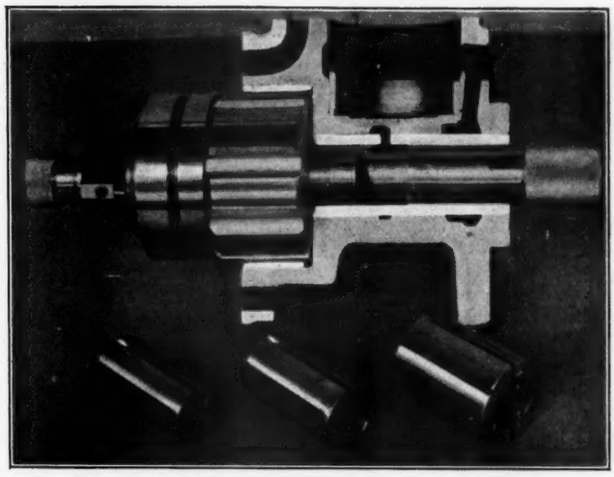
Two bolts, which pass through the base and fit the table tee-slots, serve to hold the attachment on the machine able. A raising block, to which the attachment is bolted when a magnetic chuck is used, is available when desired. The total weight of the attachment is 26 lb.

A triple valve reamer guide

THE Foster Johnson Reamer Company, Elkhart, Md., has placed on the market a sleeve and expanding adapter for piloting its triple valve reamers central with the slide valve bushings. The sleeve is bored and internally ground at the top end for receiving the pilot extending from the reamer body. The opposite end of the sleeve is threaded to receive the knurled hand nut and also a tapered seat beginning where the threaded portion of the ends are ground.

Split adapters which have tapered holes to fit the tapered seat on the sleeve are provided for the various sizes of slide valve bushing holes. Four of these comprise the complete set for the F-J AB-12 reamer.

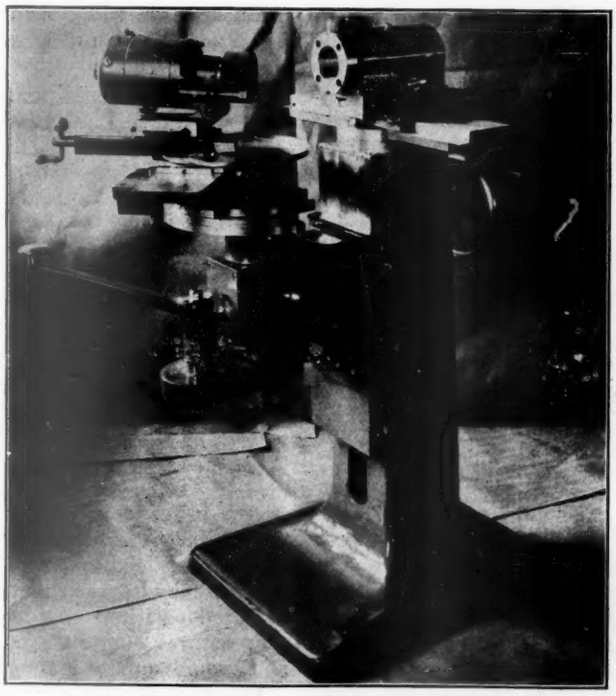
For using this device, the knurled nut is first removed from the sleeve and the proper size expanding adapter is placed over the tapered seat and the nut replaced. The entire sleeve and adapter is then inserted into the triple valve and the nut tightened sufficiently against the adapter to tighten it firmly in the slide valve bushing. The opening in the end of the sleeve is now firmly centered and ready to receive the reamer pilot.



A view showing how the Foster-Johnson triple valve reamer guide is applied

Oliver face mill grinder

A NEW type of face mill grinder which is being placed on the market by the Oliver Instrument Company, Adrian, Michigan, is shown in the accompanying illustration. The machine is adapted for grinding various other types of milling cutters and form tools and for other grinding operations requiring a radial motion of the grinding wheel, or a combination of straight and radial grinding. The extent of arc is governed by the position of two cam plates beneath the motor slide and with the plates furnished, the machine has a capacity of arcs from 60 deg. to 120 deg. included angles, but with special plates, arcs up to 180 deg. may be ground. The radius of curvature is determined by the distance of the grinding face of the wheel from the center of rotation and this can be varied from zero to about two inches. These adjustments permit the machine to handle any of the modern channeling or profile cutters.



A new type of milling cutter grinder which utilizes a combination of straight and radial grinding

The movement of the wheel carriage along its path is actuated by means of a single hand lever, the direction of motion from straight to radial or from radial to straight, taking place at a predetermined point and without any other assistance than the movement of the hand lever. The wheel carriage is also automatically locked against any other movement than the one desired. When the grinding wheel carriage is moving in a straight line, it is locked against radial travel, and when turning about an arc it is locked against longitudinal motion. The wheel carriage also changes from longitudinal to radial and reverse without shock or assistance

It is possible to grind a face mill with a different clearance on the periphery than that ground on the face and this clearance will automatically change while the grinding wheel is forming the round corner, so that the cutting edge is a smooth and even surface without interruption

The cut shows a substantial pedestal with a spindle and bearing at its upper end The spindle has the stand-

ard spindle nose adopted by the milling machine manufacturers, and is of a height convenient for mounting a cutter This bearing has a transverse and longitudinal adjustment for cutters up to 18 in. in diameter and six inches thick and with the cutter placed in position and adjustments made, the spindle bearing is locked The cutter merely rotatoes on the spindle to index various teeth so that all teeth must be uniformly ground The grinding wheel carriage is mounted on a knee having vertical adjustment and traverses a slide which is supported in a vertical bearing With the vertical bearing locked, the grinding wheel has only a longitudinal motion, and with the slide locked in its central position, the grinding point of the wheel has a circular motion, about the axis of the vertical shaft.

The motor carriage is traversed by means of a rack and pinion actuated by the hand lever, graduated plates control the extent of the circular motion and a very simple mechanical device automatically performs the locking operation.

A quick-acting hose clamp

SIMPLICITY and speed of application or removal are two of the features of the clamp recently placed on the market by the National Clamp Company, 16 East Forty-first street, New York. Fig. 1 shows the clamp open. It consists of a band upon which is embossed a series of transverse ridges and depressions, forming in effect a toothed rack. The screw engaging with this toothed band is securely mounted on a trunnion.

In applying the clamp, the band is slipped over any part of the hose and compressed by hand. This allows the screw to swing into the position shown in Fig. 2. A few turns with a screwdriver tightens the band. The screw, operating as a worm, draws in the band until it is as tight as desired. This method of tightening the band insures complete contact and equal pressure around the entire periphery of the hose. With an ordinary 6-in. screwdriver, it is possible to clamp the hose to a pipe so securely that it cannot be blown off.

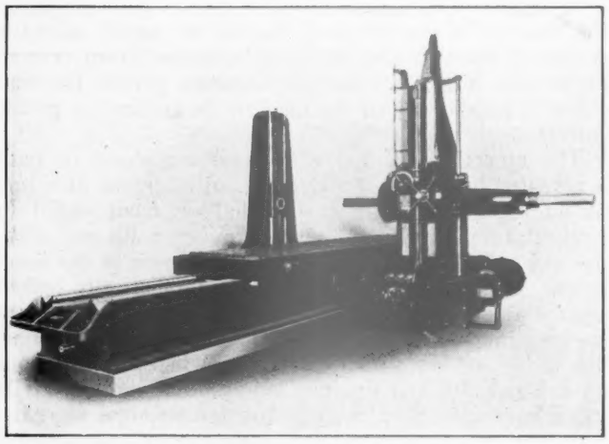
The clamp can be used for permanent or temporary water, oil, air, gas or steam connections. The clamps are made in four sizes.

Fig. 1 Fig. 2

Fig. 1 shows the clamp in the open position and Fig. 2 in the closed position

Planer type horizontal universal boring machine

PRECISION with increased capacity is the objective of the planer-type horizontal, boring, drilling and milling machine recently placed on the market by the Giddings & Lewis Machine Tool Company, Fond du Lac, Wis. This tool, which is designated as No. 45-P, offers the precision of a well built table type machine with the range of a floor type machine. The standard spindle head with its compact design is used in the machine. The feed and transmission unit with chrome alloy steel gears and also the ball bearing speed box with its twin disc clutch sensitive control, are attached to a massive bed.



The right side of the Giddings & Lewis planer type horizontal boring, drilling and milling machine showing the operating levers and the precision measuring device

The complete machine is made up of three main units bolted, dowelled and tongued together. The head, column and all the sub units for the speed, feed, etc., constitute one unit. The end support and its bed, on which it can be moved back and forth and clamped in any desired position, is another unit, which is placed on the opposite side of the table. The planer bed and table placed at right angles to the spindle, comprise the third unit.

The end support, column and their beds are of the same general design as the standard No. 45, except much larger and considerably heavier. All the features of those parts that have proved advantageous on that machine have been maintained in the new machine. On the end support the guide block always moves up and down in unison with the head.

The table and bed are of extra heavy construction, provided with large vee-ways and force feed lubrication. It is arranged for hand and power feed and rapid traverse in either direction, also with hydraulic clamps for clamping the table in any desired position. All are conveniently controlled from the natural operating position of the machine. A particular advantage claimed for this type of machine is that even for long cross travel of the table, the table does not overhang its bearings. It is always supported its full length.

The table and head movements can be arranged with the G. & L. horizontal boring machine precision measuring device. The travel of the 5-in. diameter spindle is 66 in. The number and range of speeds are 12 and 7 to 220 r.p.m., respectively. The maximum distance of the spindle above the 168-in. by 52-in. working table is 64 in. The cross travel of the table is 166 in. A 25-hp., 1,200 r.p.m. motor is recommended.

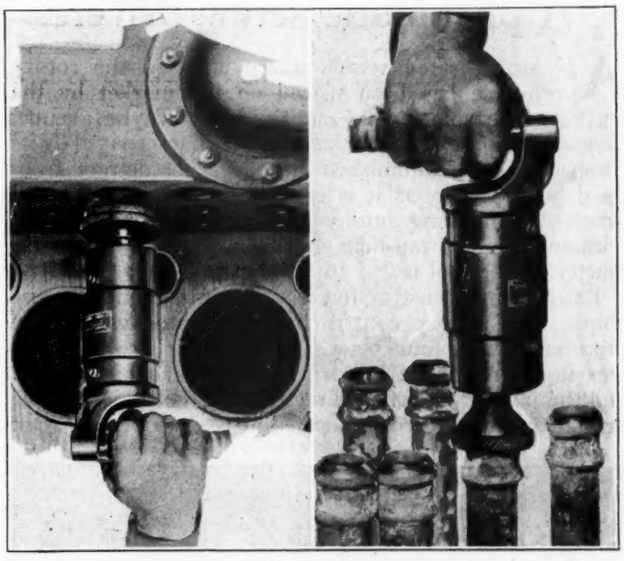
Close quarter superheater grinder

A PNEUMATICALLY-OPERATED superheater grinder, with a number of important features and advantages, including compactness which permits its use in a limited space, has been developed and placed on the market by the Sheldon Machine Company, 3253 Cottage Grove avenue, Chicago.

The grinder, known as tool No. T-19, is designed for grinding both the ball faced unit joints and the 45-deg. seats in superheater headers. It consists of a Sheldon 5,000-r.p.m. ball bearing pneumatic motor accurately balanced and of light but compact construction. It is equipped with a cam-operated throttle valve, L-type handle and Alemite lubrication, including an Alemite grease gun.

Two chucks are included which have been ground and designed for the ready application and holding of abrasive cloth segments formed by a special cutting die also furnished as a regular part of the equipment. The same abrasive cloth is used in both chucks by simply reversing the grit side of the abrasive segment when inserting it in the chuck.

The illustrations show a Sheldon superheater grinder as used in truing the ball joint on a superheater unit and also grinding a header seat. The tool is adaptable to use in back shops and also in enginehouses, being particularly valuable in the latter, when it is desirable to repair a leaking unit without disturbing any more of the other units than absolutely necessary.



Two views showing use of Sheldon close quarter grinder

All controls operated from radial drill head

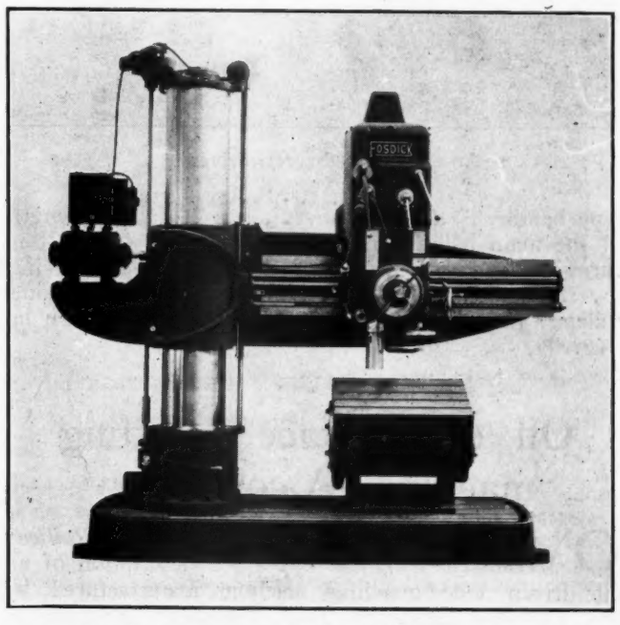
THE feature of the 5-ft., 6-ft. and 7-ft. radial drilling machines recently placed on the market by the Fosdick Machine Tool Company, Cincinnati, Ohio, is that all controls of all movements are operated at the head. The power rapid traverse of the head, built into the arm, is geared connected and operated from the head. The handwheel lever revolves when the power traverse is in operation. The power traverse unit is automatically lubricated.

The power column clamp is operated from the head by a push button. There are no dangling wires from the head to the top of the column, as the wires are automatically wound up on a reel. This unit is also automatically lubricated. The arm clamp is positively interlocked, making it impossible to elevate or lower the arm when the clamp is in position.

The spindle speeds range from 14 to 1,010 r.p.m., or from 20 to 1,406 r.p.m. All of the 36 speed changes are in the head with only 17 selective sliding gears operated with three levers. The gears and bearings are automatically lubricated with filtered oil. Eighteen selective feeds are obtainable with two levers. The range of feeds varies from .003 to .125 per revolution including pipe tap leads of 8, 11½ and 14 threads per inch. A safety interlock is provided for the feeds at high speed, and also safety feed knockouts at both ends of the spindle.

The spindle is provided with a depth dial divided into even inches. The full travel of the spindle is possible without re-adjusting the depth dial setting. The spindle is provided with an adjustable spring counterbalance in order to balance heavy tools when necessary. The spindle is prevented from falling by the safety catch.

A multiple disc start, stop and reverse friction clutch,



The Fosdick heavy duty 6-ft. radial drilling machine

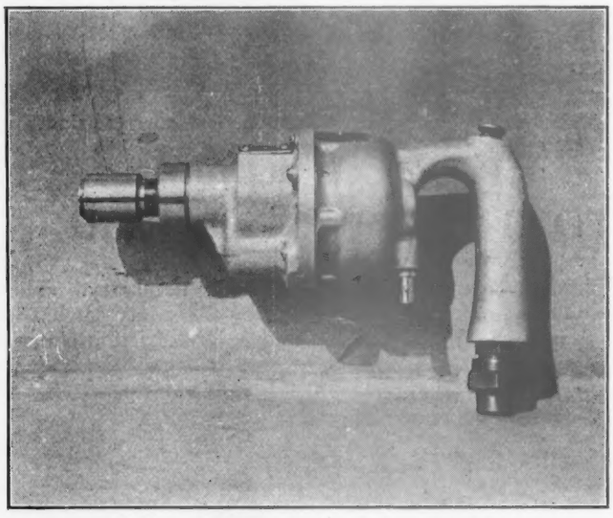
provided with a single nut adjustment from outside of the case for each friction, is used in the machine. A multiple spindle shaft with integral keys as well as the tapered roller and ball bearings are used throughout the machine. The machine is automatically lubricated throughout by a submerged oil pump in the head and the oil passes through a Purolator oil filter.

One constant speed motor drives the spindle, elevates the arm and operates the head power traverse. The driving motor is furnished by the purchaser.

A pneumatic screw driver

AN air operated screw driver built on the rotory principle has been placed on the market by the Buckeye Portable Tool Company, 135 Wayne avenue, Dayton, Ohio. Although the driver is characterized by its compactness, its diminished size does not detract from its driving power, as it is capable of driving a No. 15 screw 3½ in. long into yellow pine filled with pitch without previous tap-hole drilling. The maximum diameter of the tool is 3⅝ in.

Ball bearing construction is used throughout the machine. The rotory construction eliminates valves and vibration. The four blades of the rotor are the only wearing parts. The gears are of chrome nickel steel and the jaw clutch drives directly from the spindle. The button throttle control is located at the top of the pistol



An air operated screw driver

type handle. The length over all is 10 in., the length of the main body 6 in. and the weight 5⅜ lb. It is furnished complete with a quick change chuck having a .625-in. diameter hole with a square end for driving collets. In addition to driving screws, the tool can be used also for setting nuts and cap set screws.

Oil driven face grinding machine—A correction

ON page 700 in the October issue of the *Railway Mechanical Engineer* appears a description of an oil driven face grinding machine manufactured by the Diamond Machine Tool Company, Providence, R. I., the first paragraph of which describes the face grinder. The second paragraph reads as a continuation of the machine described in the preceding paragraph, but instead, contains facts pertaining to a surface grinding machine manufatcured by the same company, description of which will appear in a subsequent issue of this magazine.

Chain hoist equipped with anti-friction bearings

THE new Model K Cyclone hoist, manufactured by The Chisholm-Moore Manufacturing Company, Cleveland, Ohio, is constructed on the same gyrating yoke principle that is to be found in the previous model Cyclone hoists. Engineering improvements have

The Chisholm-Moore Model K Cyclone chain hoist

given the new hoist a working efficiency of 90 per cent as against 80 per cent for the previous models, and a length of life without repairs considerably longer than that of the old model.

Among the changes made in the hoist was the addition of anti-friction bearings at every rotating point. Altogether, eight ball bearings, four roller bearings and one Timken thrust roller bearing in the lower swivel hook help to increase the hoist's efficiency. One of the most important changes was made in the four eccentric roller bearings. In the old models, the rollers in these bearings were loose and had to be carefully fitted into their cage at the time of assembling the hoist. In the new model these roller bearings are built in one complete unit which does away entirely with the loose rollers.

A steel alloy was developed to increase the life of the lift wheel which is usually one of the first places to show signs of wear.

All parts of the hoist are interchangeable. It is possible to assemble all parts into the hoist frame without regard to rights or lefts, center punch marks or other generally accepted means of matching parts. The entire mechanism is enclosed in a dust-proof, oil-tight frame.

News of the Month

Long runs cut shop work

The St. Louis-San Francisco reduced its enginehouse expenses $85,000 during the first five months of this year as compared with the first five months of last year as a result of the lengthening of passenger and freight locomotive runs for varying distances—from 125 to 500 miles—and the further extension of this practice is expected to bring an additional saving of almost $250,000 a year. These runs, which are made from St. Louis, Mo., to Oklahoma City, Okla., 542 miles, and from Kansas City, Mo., to Birmingham, Ala., 635 miles. One test, with a new coal-burning freight locomotive was on a run of 2,940 miles without having the fires dropped. These long runs are eliminating the need for intermediate shop and enginehouse facilities. Forces at the intermediate terminals at Francis, Okla., Afton and Lawton; Newburg, Mo., and Thayer; and Fort Scott, Kans., have been reduced because of lack of work. Other intermediate terminals on the Frisco's various divisions are beginning to experience a reduction of work by reason of the performance of new locomotives with which the road has been replacing older ones and reductions are being made in the shops at Neodesha, Kans., and Chaffee, Mo.

Modifications made to A. R. A. Rule 36

In accordance with the modification of Paragraph 414, as shown in Supplement No. 11 to the Interstate Commerce Commission Regulations for the Transportation of Explosives and Other Dangerous Articles by Freight and Express, Section 3 of A.R.A. Interchange Rule 36 and Interpretations No. 2 and 6 thereto, have been modified, as shown in italics, effective November 1, 1927, to read as follows:

Placards or certificates missing from cars containing explosives and other dangerous articles must be replaced. Placards, commodity cards and certificates on empty cars (*except special dome placards and the optional "Dangerous—Empty" placards as per paragraphs* 414 and 1056 of the Interstate Commerce Commission Regulations), must be removed. Application or removal of such placards or certificates and also removal of commodity cards from empty tank cars, may be charged for an authority of defect cards in accordance with Rule 107.

Interpretations—(2) Q.—Section 3 provides that placards, commodity cards and certificates as required by I. C. C. Regulations for loaded cars, must be removed when found on empty cars; when removed by receiving line should delivering line furnish its defect card to cover?

A.—Yes, *except special dome placards and optional "Dangerous—Empty" placards, as provided in paragraphs* 414 and 1056 of the I. C. C. Regulations.

(6) Q.—Referring to removal of inflammable placards and caution cards from empty tank cars, is it permissible to paint over such placards when they cannot be readily removed by scraping or scaking.

A.—Under circumstances referred to, painting over of such placards is considered removal.

The following interpretation of this rule has been rendered by the Arbitration Committee:

7. Q.—*Referring to placards reading "For export beyond state," the use of which are required by state laws, per Section 5, last paragraph—can defect card be required for removal of same from empty cars, in interchange?*

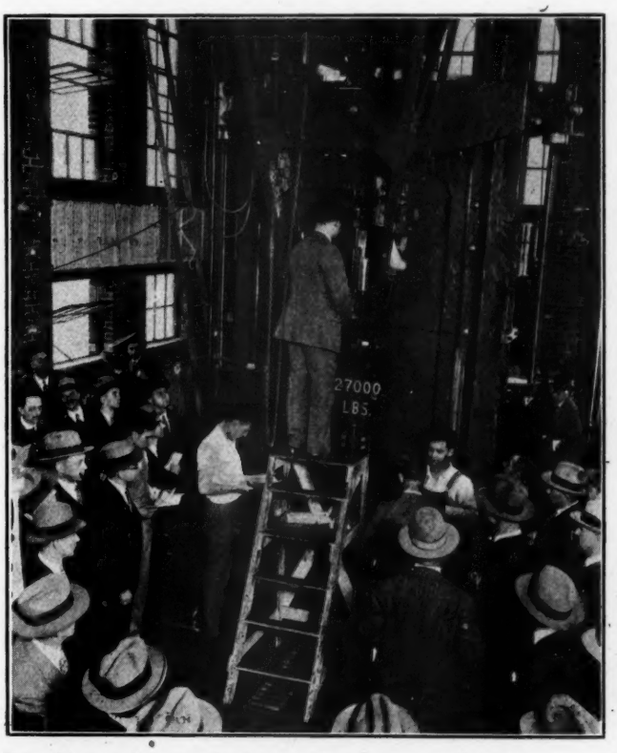
A.—*No.*

S. P. shopmen return to work

Striking shopmen of the Southern Pacific of Mexico at Empalme, Sonora, returned to work on October 31 following a decision of the recently formed Board of Conciliation and Arbitration which declared the strike to be illegal inasmuch as the employees failed to give the labor board a 10-day advance notice of their action. As a compromise the labor board requested that all men be returned to their work, allowing the road to put into effect an earlier request for a five-day week of 40 hours during seasons of slack business. The immediate cause of the strike, which took place while the request for a five-day week was pending, was the discharge of a machinist for insubordination, other employees in the shops joining in a general sympathetic strike. The five-day week request was submitted to the Board of Conciliation and Arbitration, as provided under the Mexican Constitution of 1917, only after conferences of labor committees with the general manager had failed to bring about an agreement. A recent disagreement over the interpretation of a clause in the working agreement between the Southern Pacific and its trainmen and enginemen has been decided by the labor board, in favor of the railway, the employees abiding by that decision.

A. R. A. tests inspected at Purdue

Two hundred and eighty-two representatives of 64 railroads and 53 other companies, attended the general inspection of the test laboratories in which the A. R. A. power brake and draft gear investigations are being conducted at Purdue University, Lafayette, Ind., on November 11. Many of the foremost authorities in the country on power brake and draft gear design, construction and maintenance were in attendance. The present status of the power brake investigation is as follows: Tests have been completed on the standard Westinghouse type K brake



Running a demonstration test on the A.R.A. drop test machine at Purdue University, November 11

equipment and on the equipment submitted by the Automatic Straight Air Brake Company, designed to meet tentative specifications and requirements for power brakes for freight cars set up by the Interstate Commerce Commission. Tests are now being conducted on equipment designed for this service but not recommended by the Westinghouse Air Brake Company.

Unofficial tests of the Westinghouse standard 6-ET equipment and the new FC-5 freight car equipment were conducted at

Purdue on November 11 under the supervision of H. A. Johnson, director of research. For the purpose of demonstration, a number of endurance tests were also run the same day on a Westinghouse type D-4 draft gear and a National gear, both of which were obsolete types. These tests were made on the A. R. A. drop test machine, a description of which has been published previously in these columns.

Meetings and Conventions

The next meeting of the Pacific Railway Club will be held on Dec. 10, 1927, at Sacramento, Cal., when a paper will be read on Advancement and advantages of high boiler pressures, by William G. Tawse.

Division VI—Purchases and Stores American Railway Association will meet at Atlantic City on June 13, 14 and 15, corresponding to the first three days of the meeting of the Mechanical Division and the opening of the big exhibit.

The next meeting of the Car Foremen's Association of Chicago will be held on Dec. 12, 1927, at the Great Northern Hotel when a paper will be read on Repair shop methods and facilities to produce maximum efficiency, by W. S. Dunharn, superintendent car department, Chicago & North Western.

Chicago Car Foremen elect officers

At the regular annual meeting of the Car Foremen's Association of Chicago held at the Morrison Hotel Monday, October 10, the following officers were elected for the year 1927-1928 period: President, E. H. Meckstroth, general car foreman of the Baltimore & Ohio and Baltimore & Ohio Chicago Terminal, Chicago; first vice-president, L. S. Barr, mechanical superintendent, Live Poultry Transit Company, Chicago; second vice-president, F. J. Swanson, general car foreman, Chicago, Milwaukee & St. Paul, Chicago. H. A. Simms, mechanical superintendent of the American Railway Express Company, Chicago, was re-elected treasurer and Aaron Kline, 626 N. Pine avenue, Chicago, was re-elected secretary.

Purdue University to hold welding conference

The third annual conference on the use of electric, thermit and oxy-acetylene welding as applied to manufacturing operations, is to be held at Purdue University, Lafayette, Ind., December 13, 14 and 15, under the joint direction of the Engineering Extension Department and the Department of Practical Mechanics, with the School of Chemical Engineering and the manufacturers of welding equipment co-operating. The program for this conference will include talks on welded joints in structural work; uses of welding in manufacturing operations; latest developments in thermit welding; welded joints as a mechanical and structural detail; theory and practice of gas cutting; resistance welding and its application to welding thin plates; replacing castings by means of welded frames; pipe welding; welding rods, etc. The exhibits and demonstrations will be unusually complete.

Mechanical Division convention and exhibit at Atlantic City

At a joint meeting of the General Committee of the Mechanical Division, American Railway Association, and the Executive Committee of the Railway Supply Manufacturers' Association at New York, November 16, arrangements were made to hold the 1928 convention and exhibit at Young's Million Dollar Pier, Atlantic City, N. J. Arrangements for the proper housing of the convention and exhibit include the erection of a substantial building on the ocean side of the boardwalk adjoining the pier, which will be accessible both from the boardwalk and the pier. This building will provide approximately 50,000 sq. ft. of additional floor space.

An increased demand for space for motor bus and truck exhibits is already indicated, and it is understood that inquiries are being received from a number of other companies not previously exhibiting.

The original dates for the convention, namely, June 13 to 20, decided upon at a joint meeting of the executive bodies of the two associations during the last Mechanical Division convention at Montreal, will be adhered to.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

Air-Brake Association.—T. L. Burton, 165 Broadway, New York.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

American Railway Association Division V.—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Next meeting June 13 to 20, 1928, inclusive, Atlantic City, N. J.

Division V.—Equipment Painting Section.—V. R. Hawthorne, Chicago.

Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York.

American Railway Tool Foremen's Association.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention Hotel Sherman, Chicago, August 29-31, 1928.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church St., New York.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

American Welding Society.—Miss M. M. Kelly, 29 West Thirty-ninth St., New York.

Association of Railway Electrical Engineers.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

Birmingham Car Foremen and Car Inspectors' Association.—Maynard Rodgers, secretary, care Y. M. C. A., Birmingham, Ala. Meeting second Monday in each month at Birmingham Y. M. C. A. building.

Canadian Railway Club.—C. R. Crook, 129 Charon St., Montreal, Que. Regular meetings, second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Regular meeting second Monday in each month, except June, July and August. Great Northern Hotel, Chicago.

Car Foremen's Association of St. Louis.—R. E. Giger, 721 North 23rd St., E. St. Louis, Ill. Regular meeting first Tuesday in each month, except June, July and August.

Car Foremen's Club of Los Angeles.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club building, Los Angeles, Cal.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York. Regular meetings second Thursday each month, except June, July and August, at Hotel Statler, Buffalo.

Chief Interchange Car Inspectors' and Car Foremen's Association.—(See Railway Car Department Officers' Association.)

Cincinnati Railway Club.—D. R. Boyd, 330 Beekman St., Cincinnati. Regular meeting second Tuesday, February, May, September and November.

Cleveland Railway Club.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meetings first Monday each month, except July, August and September, at Hotel Hollenden, East Sixth and Superior Ave., Cleveland.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next meeting Hotel Sherman, Chicago, August 21-23, 1928.

International Railway Fuel Association.—L. G. Plant, Railway Exchange, 80 E. Jackson Boulevard, Chicago. Next meeting Chicago, May 7-11, 1928.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash Ave., Winona, Minn. Annual convention Hotel Sherman, Chicago, September 4-7, 1928.

Louisiana Car Department Association.—L. Brownlee, New Orleans, La. Meetings third Thursday in each month.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York. Annual meeting Cleveland, Ohio, May 22-25.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in each month, excepting June, July, August and September, Copley-Plaza Hotel, Boston. Next meeting December 13. Paper on freight classification yards will be presented by George Hermauer, president, Boston & Maine.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York. Meetings third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York. Next meeting December 16. Annual dinner.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

Railway Car Department Officers' Association.—A. S. Sternberg, Belt railway, Clearing Station, Chicago.

Railway Club of Greenville.—Paul A. Minnis, Bessemer & Lake Erie, Greenvile, Pa. Meeting last Friday of each month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

St. Louis Railway Club.—B. W. Frauenthal, M. P. O. Drawer 24, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

Southern and Southwestern Railway Club.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meeting third Thursday in January, March, May, July, September and November. Annual meeting third Thursday in November, Ansley Hotel, Atlanta, Ga.

Texas Car Foremen's Association.—A. I. Parish, 106 West Front St., Fort Worth, Tex. Regular meetings first Tuesday in each month. Terminal Hotel bldg., Fort Worth, Tex.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting Hotel Sherman, Chicago, October, 1928.

Western Railway Club.—W. J. Dickinson, 189 West Madison St., Chicago. Regular meetings, third Monday in each month, except June, July and August. Next meeting December 13, at Hotel Sherman. Ladies night. Dinner and dance.

Supply Trade Notes

John R. Mitchell, representative of W. H. Miner, Inc., Chicago, died in that city on November 7.

The Waugh Equipment Company has removed its New York City office from 100 East Forty-second street to 420 Lexington avenue.

Russell Wallace, vice-president of Crerar, Adams & Co., Chicago, has been elected president to succeed E. F. Sheperd, deceased.

The Harnischfeger Corporation, Milwaukee, Wis., has opened a branch office at 194 Boylston street, Boston, Mass. E. J. Calder is district manager.

The Baldwin Locomotive Works and the Standard Steel Works Company have removed their St. Louis, Mo., offices from the Boatmen's Bank building to the Telephone building, 1010 Pine street.

E. N. Stevens, representative of the Imperial Brass Manufacturing Company, Chicago, has resigned to become assistant sales manager of the Welding Division of the Bastian-Blessing Company, Chicago.

The Morton Manufacturing Company, Chicago, has appointed Mitsui Bussan Kaisha, Limited, Tokyo, Japan, its representative for the far east, the territory including the Japanese Empire and Manchuria, China.

Jack L. Jacobson has been appointed representative in the New York territory of the Reading Iron Company, Reading, Pa. He will assist H. S. Carland, district sales representative at New York. Mr. Jacobson was formerly associated with the Barrett Company, of Chicago, Ill.

John W. Faessler, president of the Faessler Manufacturing Company, and well known to the boiler making fraternity through long association with its members, died recently at Moberly, Mo. The concern, of which Mr. Faessler was the head, was founded by his father. Mr. Faessler entered the works when but ten years of age. His father died in 1899, and in 1900 the business was incorporated and he was elected president while still only 22 years of age. In line with his plans for expansion of the business a new plant was under construction at the time of his death.

Norman Spear Lawrence, vice-president and director of sales of the Whiting Corporation, Harvey, Ill., died on October 26 after a brief attack of pneumonia. Mr. Lawrence was born on May 9, 1882, at Chicago, and was educated in the schools of his native city. He graduated from Cornell University in the class of 1904 as a mechanical engineer, and shortly after entered the employ of Whiting Corporation, as an estimator, becoming successively chief estimator, assistant sales manager, vice-president and director of sales. During the past few years Mr. Lawrence was also president of the Swenson Evaporator Company, a subsidiary of Whiting Corporation.

N. S. Lawrence

Frank K. Tutt, vice-president of the Hanna Stoker Company, Cincinnati, Ohio, with headquarters at St. Louis, Mo., has resigned to become special representative of the Bird-Archer Company with headquarters at Chicago. He was born on December 30, 1876, at Lexington, Mo., and entered railway service in August, 1891, with the Missouri Pacific. Later he was associated with the Southern, the St. Louis-San Francisco, the Denver & Rio Grande Western, the Missouri Pacific and the Missouri-Kansas-Texas. In February, 1924, he resigned from the latter road as mechanical superintendent to become a representative of the Hanna Stoker Company and in the following year was appointed sales manager and later vice-president which position he has held until his recent appointment.

Melvin J. Evans, who has been appointed sales manager for the Whiting Corporation, Harvey, Ill., graduated from the University of Wisconsin in 1913 and in the same year became a special apprentice in the mechanical department of the Atchison, Topeka & Santa Fe. Later he was employed in the mechanical assembly and boiler shops and the enginehouse and in other capacities. During the war he served as a lieutenant in the ordnance department and at the close of the war returned to private life as assistant to the vice-president of the Doehler Die Castings Company, Brooklyn, N. Y., which position he held for three years. He then became works manager of the Chicago plant of Templeton, Kenly & Co., Ltd., and after three years entered the employ of the Republic Flow Meters Company, Chicago, as sales manager, which position he held until his recent appointment.

M. J. Evans

Frederick F. Fitzpatrick, president of the American Locomotive Company, with headquarters at New York, died suddenly at his home at Larchmont, N. Y., on November 16, from an attack of heart disease. Mr. Fitzpatrick was born near Peterborough, Ontario, on June 9, 1866. He attended St. Joseph's Academy at Chillicothe, Mo., and started his career as a telegraph operator. He soon gave this up, however, to become a salesman of the Railway Steel-Spring Company. In 1898, he was appointed St. Louis representative of the Charles Scott Spring Company which was merged with the Railway Steel-Spring Company upon its organization in 1902. In 1905, three years after the formation of the present Railway Steel-Spring Company, he was made general agent, with headquarters at New York. He served in this capacity until he was elected vice-president in charge of sales in 1907. Three years later, in 1910, he was elected president and continued in charge of the affairs of this company until 1926. He then succeeded W. H. Woodin as president of the consolidated companies after the Railway Steel-Spring Company had been amalgamated with the American Locomotive Company, Mr. Woodin becoming chairman of the board.

F. F. Fitzpatrick

At the time of his death Mr. Fitzpatrick was also chairman of the board of the Railway Steel-Spring Company, and president of the Montreal Locomotive Works, the Canadian Steel Tire & Wheel Company, the American Locomotive Sales Corporation, and the Richmond Locomotive Works. He also held directorships in the American Brake Shoe & Foundry Company,

the American Car & Foundry Company, the American Car & Foundry Securities Company, the Emigrant Industrial Savings Bank, the Safety Car Heating & Lighting Company, the Seaboard National Bank, U. S. Life Insurance Company, and the Superheater Company. He was active in the affairs of the Railway Business Association and was serving as a vice-president of that organization at the time of his death.

Manning, Maxwell & Moore, Inc. organizes subsidiaries

Manning, Maxwell & Moore, Inc., New York, for the better handling of its business, effective as of October 1, 1927, has organized two operating companies under the laws of Delaware called respectively the Consolidated - Ashcroft-Hancock Company, Inc., and the Shaw Crane-Putnam Machine Company, Inc. These new operating companies were formed to take care of the expanding engineering and manufacturing interests of Manning, Maxwell & Moore, Inc., which owns 100 per cent stock of both the new corporations.

C. A. Moore, Jr.

The Bridgeport and Boston plants of Manning, Maxwell & Moore, Inc., consisting of the Hancock Inspirator Company and the Hayden & Derby Manufacturing Company, Boston, Mass., and the Ashcroft Manufacturing Company and the Consolidated Safety Valve Company, Bridgeport, Conn., and the sales force marketing the products of these plants will make up the Consolidated-Ashcroft-Hancock Company, Inc. The operations of this company will include the development of new devices for power plants, steam locomotives and marine service, as well as the sale and manufacture of the present extensive line of steam specialties.

The Shaw Crane-Putnam Machine Company, Inc., takes over the Shaw Electric Crane Company, Muskegon, Mich.; the Putnam Machine Company, Fitchburg, Mass., and the sales activities pertaining to them. The operations of this company will include the engineering development of new mechanical machines and devices, as well as the manufacture and sale of the present line of electric traveling cranes, heavy machine tools for industrial and railroad service, and special production machinery.

The supplies department and the Chicago machinery branch office of Manning, Maxwell & Moore, Inc., operate as formerly.

This arrangement has been made after long consideration of the diverse and unrelated parts of the business of Manning, Maxwell & Moore, Inc., and is intended to co-ordinate the several parts of the business more adequately.

The officers of Manning, Maxwell & Moore, Inc., are: C. A. Moore, Jr., president; H. D. Carlton, E. M. Moore, F. J. Baumis and J. D. Nicklis, vice-presidents; F. W. Knowles, controller, and F. M. Kreiner, secretary and treasurer.

The officers of the Shaw Crane-Putnam Machine Company, Inc., are: C. A. Moore, Jr., chairman board of directors; F. J. Baumis, president; F. W. Knowles, vice-president and controller; F. M. Kreiner secretary and treasurer; E. L. Fickett, assistant to president.

The officers of the Consolidated-Ashcroft-Hancock Company, Inc., are: C. A. Moore, Jr., chairman board of directors; H. D. Carlton, president; W. H. Williston, vice-president; C. H. Graesser, vice-president; F. M. Kreiner, secretary and treasurer; F. W. Knowles, controller.

All companies have headquarters at 100 East Forty-second street, New York. The oldest unit, the Putnam Machine Company, started business in 1836; the Ashcroft Manufacturing Company in 1852; Manning, Maxwell & Moore in 1873 and the Hancock Inspirator Company in 1877.

Personal Mention

General

F W. Hankins, chief of motive power of the Pennsylvania, with headquarters at Philadelphia, Pa., has been appointed to a similar position on the Long Island, with the same headquarters.

F. H. Murray, master mechanic of the Western district of the Erie, at Cleveland, Ohio, has been appointed mechanical superintendent with headquarters at Hornell, N. Y., succeeding Mr. James.

Master Mechanics and Road Foremen

George C. Jones, who has been appointed master mechanic of the Atlantic Coast Line, with headquarters at Jacksonville, Fla., was born on August 2, 1874, at Fayetteville, N. C. He attended the Donaldson Academy at Fayetteville, and in April, 1890, entered the shops of the Cape Fear & Yadkin Valley Railway at Fayetteville. He served as a fireman and was promoted to locomotive engineer in 1896. When the Cape Fear & Yadkin Valley Railway was absorbed by the Atlantic Coast Line in 1898, Mr. Jones was transferred to Florence, S. C., and from April 14, 1899, until December 20, 1909, his run was over the Columbia and Charleston districts. On the latter date he was promoted to road foreman of engines, and in 1920 he was appointed general road foreman. He was general road foreman at the time of his recent promotion to master mechanic at Jacksonville.

G. C. Jones

Shop and Enginehouse

A. D. Haley, roundhouse foreman of the Illinois Central, has been appointed general foreman, with headquarters at McComb, Miss.

Norbert J. Freiert, passenger car foreman of the Erie, with headquarters at Buffalo, N. Y., has been appointed shop superintendent, with headquarters at North Hawthorne, N. J., succeeding John T. Munroe, retired. Mr. Freiert was born on September 2, 1893, at Buffalo, N. Y. He received an elementary school education, and, in May, 1912, entered the employ of the Erie as a draftsman. In October, 1918, he became passenger car truck foreman.

Car Department

I. G. Burke has been appointed general coach shop foreman of the Denver & Rio Grande Western, with headquarters at Denver, Colo.

Purchases and Stores

M. E. Bailie, division storekeeper of the Missouri Pacific at Kansas City, Mo., has been promoted to district storekeeper, with headquarters at St. Louis, Mo., succeeding E. A. Porter.

Walter C. Oke, chief clerk to the division storekeeper on the Michigan Central, with headquarters at St. Thomas, Ont., has been appointed division storekeeper at that point succeeding F. V. Tenkonohy, who has been transferred to West Detroit, Mich.